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HEALTHY LIVING

WINSLOW



BOOK ONE

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HEALTHY LIVING

BOOK ONE

HOW CHILDREN CAN GROW STRONG
FOR THEIR COUNTRY'S SERVICE

BY

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ENLARGED EDITION

WITH A CHAPTER ON "PHYSICAL EXERCISES"

BY

WALTER CAMP



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TO THE CHILDREN WHO MAY USE THIS BOOK

When I was asked to write a book for you about the wonders of the human body and the things we can do to keep that body strong and well, it seemed at first that I must refuse, for, like every one else, I am very busy in this war time. Gradually, however, on thinking the matter over I decided that there was really nothing at all that could be more important to do than this. We who are working in our laboratories studying about the human body and its microbe enemies are doing it because we want to help people to live healthier, happier, and more efficient lives. How can we be of any use, however, unless we tell every one what we are finding out, and, particularly, unless we tell it to you children who will soon grow up to be men and women and run this United States of ours, and yours?

The more I thought about it all, the more interested I became. I often speak face to face to classes of school children about public health; but during the last few months I have been traveling a good deal on sanitary work connected with the war, and have been thinking about a much larger audience than could be gathered in the largest room in the world. I have crossed the whole of Asia and a good part of Europe, and I have seen the boys and girls of Russia and Siberia, and the boys and girls of China and Korea, and the boys and girls of Japan with their merry smiles and their gay dresses. I have learned that the great need in all these countries is for more schools and better schools; and I have realized more than ever how much the great schoolhouses in our cities really mean, and the little schoolhouses, too, out on the ranges of Montana and among the rich cornfields of Indiana and in the pitch pine forests of Florida. I finally decided that nothing could possibly be better worth while than to talk through this little book with so many children whom I

4 TO THE CHILDREN WHO MAY USE THIS BOOK

have never seen and shall never see and to tell them something about health.

So I have tried to describe to you how the human body is built and how it works. I have told you something about our invisible enemies, the microbes, which we must know how to fight, as our forefathers fought the wild beasts when they settled this great country. Health means, first of all, running the living machine, the body, so as to keep it in good working order; and, second, guarding it against the attacks of these enemies that may come in to harm it from without.

I have been anxious to make you feel the wonder and the interest of this body of ours, for it is really one of the most wonderful and interesting things in the whole world. Some of the principal points which we ought to remember about keeping the body well are illustrated by stories, for there is nothing that children, and some of us grown people too, like so much as a story. Finally, I have emphasized all through this book the fact that we ought to try to be strong and well, not for our own sakes but because we are citizens of a great country which needs our best service. Loyalty to the common tasks of the American Democracy is the first and the foremost lesson which our schools must teach; and strength for service—strength physical, strength intellectual, strength of character and purpose—is the foundation of that loyalty.

Thanks are due to my daughter, Nancy, aged ten years, for reading the manuscript of this book and criticising it from the standpoint of the children who may use it. If the book succeeds in interesting you and in helping you to keep yourselves in sounder and more vigorous health, I shall be very grateful for the chance of telling this story of the human body and how to keep it well.

C.-E. A. WINSLOW.

New Haven, Connecticut,
May, 1918.

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HEALTHY LIVING

CHAPTER I

A WELL-SPENT DAY

How a Boy Became a Knight.—Five hundred years ago, in England and France and the other principal countries of Europe, the leaders of the people were a special class of men called knights. A knight had to be a soldier, absolutely free from fear. He must always be true to his king and his country and his friends. He must be generous and ready to give away anything he had to those in need. He must always be modest and courteous in his manner and thoughtful of the feelings of others. So people came to feel that there was nothing nobler in the world than to be “a good knight.”

It was not easy to become a knight. The boy who desired this great honor went through a long period of training. It began when he was seven or eight years old. He waited on, and helped, the older people in the household, and was trained there in courtesy and gentleness. As years went on, he learned how to carry himself like a soldier and how to use the spear and the sword, with which men fought in those days. He learned to ride and swim and climb and jump, and he trained himself to bear the heavy weight of the suits of armor which the knights wore in battle. As he grew older, he learned to endure heat and cold and to go for

a time without food or sleep, so that he might be strong to bear the hardships of the life of a soldier. At last,



Fig. 1.—How a boy of the olden time was made a knight.

after perhaps fifteen years of this training, he was brought before the king of the country, and as he kneeled down the king touched him on the shoulder with his sword and made him a knight.

We do not have knights of this kind in America to-day; but we want boys and girls who will serve our country as faithfully as the knights of old-time served their king. We honor men and women who are brave and loyal, generous and gentle—just as they did five hundred years ago. It is just as true as it was then that girls and boys cannot grow up to be good citizens and faithful servants of their country, unless they train themselves to be strong, as well as to be brave and true and kind.

Perhaps you have thought that people just happen to be well or ill, strong or weak, and that there is nothing you can do about it. That is not true, for health and strength come largely from habits of healthy living. In order to form such habits, you must know something about your body and how it works and what you can do to make it stronger. In later chapters I shall tell you more about the body and the reasons why some habits are good and others bad. There are some things, however, that we all know about, though we may not always remember to do them. Let us see what a few of these things are, and how a boy or a girl can spend a day—say to-morrow, the day after studying this chapter—so as to build up strength and health for the knightly service of our country.

Getting Ready for the Day.—First of all, the boy who wants to be a good knight and the girl who is eager to grow up into a strong, helpful woman will not, of course, linger in bed when the time for getting up has come. In winter it is not easy to step out of the warm bed-

clothes into the cold world, but if you set your teeth you can do it just the same. Then the body should be made ready for the work of the day by a cold bath and a brisk rubdown with a rough towel. Just why this is healthful, and how a cold bath helps you to feel fit and strong, we shall learn in later chapters. Often one



Fig. 2.—Health habits: brisk morning exercises.

has to do what one is told quickly and without asking the reason; but it is much nicer to know the reasons for things and really understand why they are good. The teeth must be thoroughly brushed, and the face and hands washed, so as to be clean and fresh for the new day. There are some interesting reasons for this, too, which you will learn later, for we do not try to keep clean simply because dirt does not look well.

Morning Exercises.—The arms and the legs that are so active in the daytime have been limp and quiet during the night's rest. It is an excellent plan to get them into good working order by a few simple exercises, which will be described in a later chapter. If you do these exercises every morning, and breathe slowly and deeply while you are doing them, not only your arms and legs but a great many other parts of that complicated and wonderful body of yours will be helped

and strengthened. You will find, if you do this, that you will grow stronger all the time, and better able to play games and run and jump and climb; and you will find yourself happier and more full of life and energy in everything you do.

After you have put on your clothes and are ready to go to breakfast, stop for a minute and think whether you are holding your body proudly and well, or whether you are slouching. See that your head is up, your shoulders flat, your knees straight, your feet set squarely on the ground, before you set out for your day's work.

Mealtimes.—Which meal in the day do you like best? I think breakfast is perhaps the pleasantest. It is early morning and everything is fresh and bright and one is almost always hungry then, particularly if one has had a bath and vigorous exercises.

Sometimes a child, who is not trying to grow to be a strong man or woman, lies in bed so long and is so slow in dressing that there is no time for breakfast, and he just snatches a mouthful or two before running off to school. This is a very bad plan indeed, for soon that child will begin to have an empty feeling inside; he will become cross and fretful and will be stupid in school work and dull at play. Remember that the body



Fig. 3.—Health habits: hearty and wholesome meals.

needs plenty of food, and no child can be of very much use to himself or anyone else unless he has started off in the morning with a good breakfast.

Most children need a little lunch in the middle of the morning, for it is a long time between breakfast and luncheon or dinner time. So it is a good plan to take with you some bread and butter or crackers or cookies to eat about eleven o'clock.

You will read later in this book about the foods that make up a good diet for a boy or girl of your age. For breakfast you should have fruit, cereal, bread and butter, and milk, or other foods equally good. A little meat or fish or eggs should be eaten sometime during the day, if possible; but plenty of milk will do instead, if these things are too expensive. Green vegetables or fruit should form a part of each of the three meals. You will learn later what each of these kinds of food does for the body and why you need them all.

The boys who were training themselves to be knights in olden days sometimes used to go without any food for a time, to make themselves hardy. It is good to be brave about being hungry, but it is not worth while to injure one's health by going without food just for this purpose. There is another kind of training, however, which some children I know need very much. These children go without food of certain kinds, not to make themselves hardy but just because they don't like chicken or carrots or spinach or whatever the food may be. Often the foods they will not eat are just the ones they need to strengthen their bodies and make

them grow. Such children should make it a part of their knightly training to conquer their dislikes and to learn to eat all the good kinds of food that are set before them.

Dressing to Go Out.—After breakfast is finished, there is often a hurry and a scurry to get off to school. The house is full of cries of, "Mother, where are my gloves?" and "Mother, I can't find my coat."

It pays to take time to find the clothes you need before you go out into the chilly air, if it is winter time or there is a storm. It may be a bother to hunt for your things. But remember that you cannot expect your body to keep fit and well, if you do not take care of it. Dressing too warmly is



Fig. 4.—Health habits: clothes to suit the weather.

bad; but wearing coats, warm caps, overshoes, mittens, and leggings, when the weather is such that you need them, is not a sign of being babyish but a sign of being sensible and grown up.

Don't forget, however, to take off coats, leggings, and mufflers when you go indoors where it is warm. Rubbers are very bad for the feet, if you forget and keep them on all day, as some children do that I know about.

Schooltime.—The different parts of the body are like faithful servants who do our work for us most of the

time, even without our having to think about it at all. Some of these parts, as we shall see, are busy all day and all night. Others are set to work only now and then when we happen to need them.

At school and in home-study time we call upon our very highest servants to help us. They are the parts making up the brain, with which we do our learning and understanding. You can make these servants either good or bad by training them. If you idle your time away and look out of the window and whisper and giggle, your brain servants will get the habit of idleness and inattention. If you are trying to make yourself a good knightly citizen, you will make your brain servants nimble and industrious by working—when you do work—with all your might.



Fig. 5.—Health habits: quiet and concentration in study time.

Outdoor Play.—In the afternoon the young knight, whether boy or girl, will get outdoors if possible, for there is nothing so good for us as fresh air and sunlight. Games and sports in the afternoon are just as important a part of your training as studies in school-time. Almost all kinds of exercise are helpful, but particularly those that bring all the parts of the body into play, such as running and skating and tennis. Games that

are played by teams against each other are best of all, for they not only help you to be physically quick and strong, but also show you how to play and work with others. Most of the things that are worth while are done by men and women working together. If you keep playing with all your might, all the time, to help the rest of the team win, without looking for any special glory for yourself—you will surely make a good citizen in after life.

Indoors Again.—In the late afternoon and after supper, or when it is too stormy to be out, there are other interesting things to do. Sewing for girls and carpentering for boys, and story books for both, are waiting for you, with many other ways of passing the time as well. Even in these hours, however, that little body of yours should not be entirely forgotten.

In the first place, remember that it needs fresh air even when you are indoors. If the room gets too hot, open the window and freshen up the air for a few minutes, and you will get more enjoyment from whatever you are doing and you will do it better.

When you are sitting quietly reading, your habits of holding your body are being formed, as much as when



Fig. 6.—Health habits: vigorous play in the open air.

you are walking or running about. Don't loll and sit on the middle of your back with your feet on the chair or sofa. Old people and sick people and tired people may need to rest in this way, but a child should be able to sit up, straight and strong.

Don't forget to give your eyes a chance, too. Those two eyes are among your very best and most useful servants. Keep them strong and clear by always having a good light when you read or sew.



Fig. 7.—Health habits: a good night's rest.

Bedtime.—At last bedtime comes. The body that has worked hard all day must rest and grow, so as to do still more to-morrow. Don't shorten the sleep time that it needs.

The teeth must be brushed again. And then—to bed, in a room with the window open to let in the cool fresh air, and off to the land of dreams with the memory of a well-spent day!

QUESTIONS FOR DISCUSSION AND REVIEW

1. What was a knight? What did a boy have to do to become a knight?
2. Do we have any knights in America? What qualities that the knights had are still needed to-day?
3. Is it important that girls as well as boys should be strong and healthy? Why?

4. Is illness ever a person's own fault? Try to think of some cases in which illness would be the result of bad habits.

5. What are the things that a boy or girl should do before breakfast to get ready for a good day? How many of them did you do this morning?

6. George was very sleepy one morning and lay in bed till it was nearly time to start for school. He drank one mouthful of milk and took one slice of bread to eat as he ran, and he forgot the lunch he generally took to school. Tell how you think George felt during the morning, how he got along in his lessons, and how well he played in the ball game at recess.

7. Why are games that are played by teams with several on a side better than games that are played alone?

8. What are some of the things you can do to keep your body strong and well when you are reading or sewing at home in the late afternoon or evening?

CHAPTER II

YOUR WONDERFUL BODY

Living Things and Lifeless Things.—What are the things that interest you most as you walk home from school or wander about in the woods? Smooth shiny stones are attractive, particularly if they have bright colored specks in them. If you are like most children, however, you find flowers more beautiful than stones—and there are a great many more kinds of flowers than there are of stones. Animals are most interesting of all. Beetles crossing the path, butterflies slowly waving their wings on a thistle head, frogs in the meadow, fishes in the stream, squirrels in the trees, or birds balancing on the telegraph wires,—how fascinating it is to try to get near them and see what they are doing!

It is the same in the city. It is pleasant to see the automobiles gliding by and to look up at the buildings and think how high they are. Most of us, however, would rather watch a good horse than an automobile; and the most interesting things to me about the houses I pass are the cats on the window sills and the dogs playing about the doorsteps.

The flowers, butterflies, birds, squirrels, cats, and dogs are all *alive*; and life is, after all, the most wonderful thing in the world.

The Human Body.—The most wonderful of all kinds

of living things are men and women (and of course girls and boys). We cannot "run like a deer," nor is any man "as strong as a horse," though we often use these expressions to mean that a person is unusually



Fig. 8.—There are many fascinating things in the world but none that are quite so wonderful as the living machines we call animals and birds and boys and girls.

quick or unusually powerful. When it comes, however, to things which need skill and delicacy, no animal can match us. You have probably seen a conjuror do his tricks with cards and coins, moving his fingers so swiftly that you could not guess how he managed to make something disappear that had been right under your eye the minute before. Or you have watched a

good tennis player and wondered at the way in which he gets just to the place in the court where the ball is coming, and hits it back so that it barely skims the net and goes to the one spot where it will be hardest for his opponent to return it.

The human body is in some ways very much like a bit of machinery—a watch or a steam engine—but it can do many things that no lifeless machine will ever do. We all like to know how machines work; for instance, how the burning of gasoline in an automobile makes the wheels go round. We ought to be still more eager to learn how our own body-machine works. Do you know why you have to breathe and eat and sleep; how you move about; how the blood circulates in your body; and how you learn to do things like riding a bicycle or playing the piano, which become so easy at last, though at first you could hardly do them at all?

It is interesting to learn about all the things that go on inside that body-machine of yours. It is also very important to learn about them, because when you know how a machine works, you can make it run well and get the most possible out of it. The art of keeping the body-machine in good order is called **hygiene**.

The Parts of the Living Machine.—One of the striking things about a machine is that it is always made up of many different parts, each of which performs some special part of the work. Think whether this is not true of the human body. First of all, the body is divided into the trunk, head, arms, and legs. You know what the arms and legs are for, but it might be in-

teresting to make a list of the things you can do with each and see which list is the longer one.

The trunk contains many important parts of the body. Some of them are shown in Fig. 9, and we shall later learn what they are like and what they do. The head includes the brain, where our thinking and feeling goes on. It contains also the eyes with which we see, the nose through which we breathe and smell, the ears with which we hear, and the mouth and throat and tongue with which we eat, taste, and speak.

The body inside is not solid like a stone, but is made up of different kinds of living matter. In your fingers, for instance, you can feel under the skin soft matter with something hard beneath it; and you know, from having cut yourself sometime, that in the soft matter there is a red liquid, the blood.

A living body, then, is made up of different parts, each having some work to do for the common good. These parts are called **organs**.

There is a fable told by the ancient Greek, Æsop,

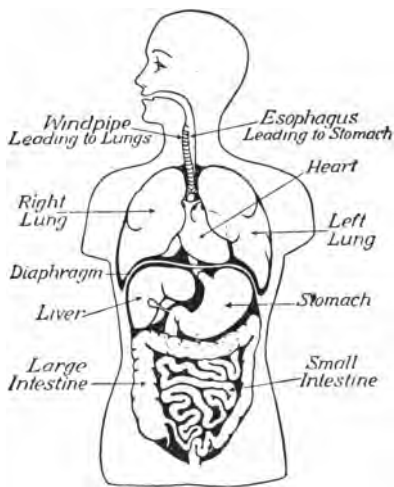


Fig. 9.—Some of the principal parts of the living machine.

which illustrates very well the way in which each part of the body depends upon every other part. Once upon a time, he tells us, the different parts of the body could think and talk and act for themselves. The other organs decided that the stomach was having altogether too easy a time of it. They were tired of working to

put food into him while he was doing nothing. So the hands refused to carry food to the mouth; the mouth refused to swallow; the teeth refused to chew. Very soon the organs which had made this agreement among themselves began to suffer. All the time the stomach had been sending food back to them, and they found they could not live without it. At last they concluded that they could not get



Fig. 10.—The bones of the hand.

along without the stomach any better than he could get along without them.

The Organs by Which the Body Moves.—Bend your finger and notice what happens. It bends at two places, does it not? These bending places are called **joints**. Between the joints, the finger is quite rigid and cannot be bent at all. This is because the finger is strengthened and supported by solid pieces of **bone**. The bones are fastened together at the joints in such a way that

they can move up and down. Think what the hand would be if it lacked this bony framework and were soft and flabby; or if the joints were not there and the hand were in one stiff piece. Sometimes in certain diseases the joints do stiffen so that the fingers cannot be moved and the hand becomes almost useless.

The arms and legs are supported by large bones and can bend only at the joints where the bones meet. The upper part of the trunk is enclosed in a cage of bones, which you can feel moving up and down when you breathe deeply. The brain is enclosed in a box of bone. These bones help to protect the softer parts inside. All the bones of the body together make up the **skeleton**.

Did you ever wonder how it is that you are able to move the different parts of your body at all? What happens inside your hand when you bend that finger we have been thinking about?

Every movement of this kind is caused by a special sort of living matter in the body called **muscle**. The muscles are fastened at each end to bones. They have the power of growing shorter; and when they shorten, they change the position of the two bones to which they are fastened.

Food and Digestion.—An automobile will not go unless it has gasoline to burn or electricity in its storage battery. A steam engine will not run unless coal is put in under its boiler. The gasoline, or electricity, or coal, supplies what we call **energy** to run the machine. The body is just the same, in this respect. In order to

live and move and grow, it must be given food, for food is to the body what gasoline is to the automobile or coal to the steam engine. The more active we are, the more food we need; and without food we become weak and waste away.



Fig. 11.—An automobile must be supplied with gasoline in order that it may run.

Several things must happen to our food before we can use it. It must be broken up into a fine pulp by the teeth, and then swallowed, and then changed in the stomach and other organs before it can be used. The process of preparing the food for the use of the body is called **digestion**. As

Æsop has taught us in his fable, the work of the organs of digestion is very important for the health of the body as a whole.

Breathing.—You probably know that the fire in the kitchen stove will not burn well unless there is a good draft, or current of air. There is something in the air called **oxygen**, which makes a fire burn. If a piece of burning wood in the fireplace were covered with ashes so that the air could not reach it, the fire would soon go out.

The body is like a fire, in the fact that it must have

oxygen all the time; and this is the reason why we breathe. We can go without food for hours or even days, but we cannot live for many minutes without breathing, or taking in air. The organs by which we draw the air in and get oxygen from it are called the organs of **respiration**. (The word *respiration* means breathing.)

Do you know how many times a minute you breathe? Watch the clock some day and count your breaths for a minute.

The Heart and the Blood Vessels.—The food is taken in by certain organs of the body, and the oxygen by others. Somehow these things must be carried to every part of the body, for all the organs need them in order to keep alive.

The special organs which do this work—the railroad system of the body—are the **heart** and the **blood vessels**. You know that the blood seems to be in all parts of the body, for when you cut yourself deeply anywhere the blood flows. All through the living parts of the body



Fig. 12.—A child must be supplied with food in order that it may live and grow. It gets its energy and strength from the food, much as the automobile gets its power from the burning of the gasoline.

the blood is carried, inside a system of closed tubes, the blood vessels, which branch like the branches of a tree, getting finer and finer. Through each tube blood is moving; and whenever blood flows from a cut or a scratch, it is because the walls of some of these fine tubes have been broken.

The blood is driven through these blood vessels by the heart. This organ beats nearly a hundred times a minute, each beat forcing blood out into the blood vessels. Everywhere the blood goes, it carries with it the food and the oxygen needed by the different parts of the body.

You can feel your heart beating away as regularly as a clock ticks, if you put your hand on the left side of your chest. You will learn in Chapter XI what the heart is like and how it does its work.

The Brain and the Nerves.—We have seen that a movement like the bending of your finger is caused by the shortening, or contraction, of a muscle. But what makes the muscle contract? When you make up your mind to bend one special finger, how is the message carried to the right place?

This task of keeping all parts of the body working as we want them to work is accomplished by a group of organs which we call the **nervous system**. The brain, where our thinking goes on, is connected with all parts of the body by tiny white threads called **nerves**. It is along one of these nerves that the message goes out from the brain when you make your finger bend.

The nervous system does much more, however, than

merely make it possible for us to move various parts of our bodies as we wish. All the time, whether we think about it or not, a great many things are going on inside our bodies, like the breathing and the beating of the heart. All these activities are kept going in an orderly fashion by messages which are constantly passing from one part of the body to another through the nerves.

The principal parts, or organs, of the body are:

The bones.

The muscles.

The organs of digestion.

The organs of respiration.

The heart and the blood vessels.

The brain and the nerves.

We shall want to learn a little more about each of these kinds of organs and how they work, in later chapters.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Divide all the things you can see in the schoolroom into living things and lifeless things. Then see what differences you can think of between lifeless things as a group and living things as another group.

2. What is the study of hygiene? Why is it important?

3. Can you think of ways in which the body is like some machine that you know about?

4. Which is better off: a dog with four legs or a man with two legs and two arms? Why?

5. What is an organ? See how long a list you can make of the different organs of the body.

6. Tell in your own words the fable of the stomach. What lesson does it teach?

7. What are the organs by which the parts of the body are moved?

8. When are you more hungry: after a hard play out of doors or after a rainy afternoon spent in the house with a book? Why?

9. In what way is the body like a fire? Why does a fire go out when it is covered with ashes?

10. Of what use is the blood to the body?

11. Write a fable like Æsop's fable of the stomach, telling in story form what would happen if the nerves decided not to carry messages to the muscles any more.

CHAPTER III

THE FRAMEWORK OF THE BODY

The Importance of the Bony System.—If you have ever been at the seashore, you have probably seen jellyfishes swimming in the water, like clear glassy bells; and you have perhaps noticed some of these same jellyfishes washed up on the sand and looking then like mere lumps of lifeless jelly. They have no bones or hard parts at all, and outside of the water they are quite helpless.

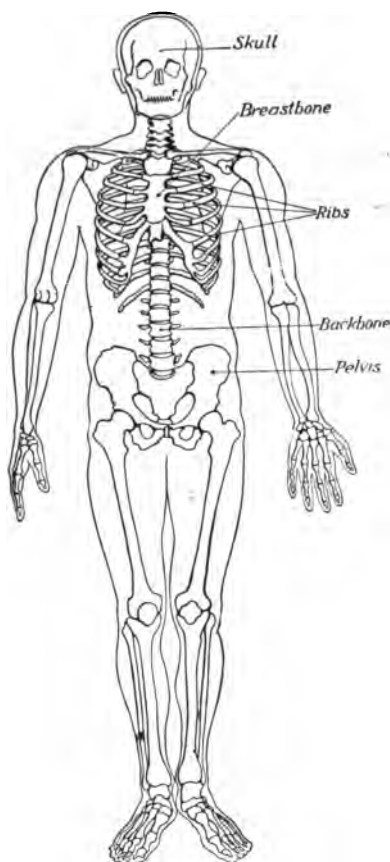
Most animals that live and move about in the air, and many of those that live in the water too, have some sort of **skeleton**, a system of hard parts which gives their bodies firmness. All the animals which can move quickly and powerfully must have a skeleton, for quick movement requires the shortening of strong muscles, fastened at each end to parts that are firm and rigid.

Sometimes the skeleton of an animal is on the outside, as in the case of a beetle or an ant; sometimes inside, as in the case of the bones in our own bodies.

What the Bones are Made of.—We often think of the bones as dead things. They are made up, for the most part, of a mineral lime, which is found in limestone, but they have living matter in them too. If bones did not contain living matter, they could not grow; and if you think about it, you will see that, as a child

grows, its bones must be growing too. It is important for children to drink plenty of milk, because milk

contains a great deal of the lime out of which new bone is made.



The General Plan of the Skeleton.—The general arrangement of the bones in the human body is shown in Fig. 13. You will notice, if you look at this picture, that in the central part of the body (the trunk) there is a strong **backbone**, with the **ribs** attached to it in the upper part, and a pair of flattened bones which make up the **pelvis** below. The pelvis is a sort of bowl which helps to support the soft organs in the lower part of the trunk.

Fig. 13.—The bony framework of the body.

At the top of the backbone, in the head, is the **skull**; and down

the center of the arms and legs there run rows of bones which branch out into the fingers and toes.

The Bones and the Joints.—There are about two hundred bones in the whole body. They differ very much from one another in shape and size, according to the work they have to do. Some of them are fixed firmly to each other, but at many places the bones are fastened together in such a way that they can be moved in certain directions. Such a place is called a **joint**. Perhaps you have seen men in the circus who could put their feet up behind their heads and almost tie themselves into bowknots. They show us how the power of bending the joints can be developed by exercise. In very old people, on the other hand, the joints sometimes become so stiff that they can hardly be moved at all. This is one reason why those who are young and strong should be ready to run errands and help old people in every way they can.

There is a great deal of difference between the kind of movements we can make with different joints, depending on the ways in which the bones are fitted together. Notice the kinds of movements you can make at your shoulder, your elbow, and your wrist.

The Backbone and the Ribs.—The part of the skeleton which keeps the trunk erect is the **backbone**. It is so important to the body that it has become a symbol of strength of all kinds. We say that a person who is weak and easily influenced has “no backbone,” because a person without a backbone could not stand up alone and would be almost as helpless as the jellyfish we were thinking about a little while ago.

The backbone is not a single bone, as you might

think from the name, but a row of more than twenty separate bones, each one in the shape of a rather thick ring. These rings are held quite firmly together by bands of muscle, but these muscles "give" so that we can bend the body from side to side and from front to

back. Some people can bend the body more easily than others. Stand with your feet together and your knees straight and your arms up over your head; then see if you can swing your arms down and touch the ground in front of you.

The curved, hoop-like ribs form a cage to protect the important organs in the upper part of the trunk. They are joined to the backbone at the back, and to a bone called the breastbone in the front. The ribs are attached to the backbone in such a way that they and the breastbone together can be raised and lowered slightly as we breathe. Breathe deeply and notice how your ribs rise and fall.

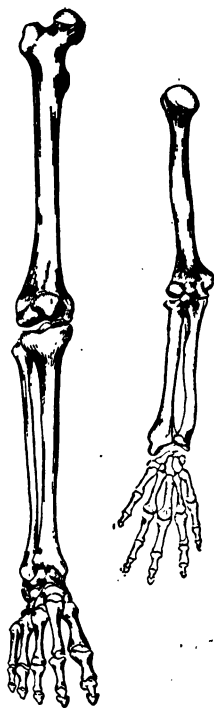


Fig. 14.—The bones of the leg and arm.

The Skull.—It is very important that the brain should be protected from any injury. The bones of the head which form the skull are specially arranged so as to do this; they are not movable like so many of the bones of the body, but are joined firmly together to make a tight case or box. There are openings

below for the nerves to come in from the trunk, and openings in front for nerves from the eyes and nose.

The Bones of the Arms and the Legs.—The general arrangement of the larger bones in the arms and the legs is shown in Fig. 14. Notice that arms and legs are built very much on the same plan, the part above the elbow or knee being strengthened by a single large bone,



Fig. 15.—One boy stands well, one slouches, and one holds himself with unnatural stiffness. Can you tell which is which?

(Used by courtesy of the American Posture League.)

the part below by two bones side by side. Five rows of smaller bones run out through the palm of the hand and the upper part of the foot, into fingers and toes.

Holding the Body Well.—We all have the same kind of framework in our bodies; but you would hardly think so to look at the people you meet in the street, or perhaps even at the children in your schoolroom. Some are erect and strong and well-balanced on their feet

so that it is a delight to look at them, while others are stoop-shouldered and slouching, with bent back and head run forward. The bones are the same in each case. It is only that one person has trained his muscles to hold the bones in place, while the other has let the muscles grow slack and loose and has become as much like the jellyfish as he possibly could.

If you hold your body correctly, a line dropped from the front of the ear should fall within the front half of the foot when you are standing still. The shoulders should be flattened, the head up, the knees straight, the feet set squarely side by side and pointing straight forward. When practicing a good position, try to "stand tall." In sitting, the body should be bent only at knees and waist, the head, neck, and trunk being in one straight line.

The habit of holding the body properly is important, not only for the general appearance of the body, but for health and strength as well. In a stooping, slouching body, the inner parts are crowded together and injured so that they cannot do their work well. Boys and girls who have the habits of clasping their hands behind their backs, folding their arms tightly in front, or placing the hands on the hips with the thumbs forward are very likely to be round-shouldered and flat-chested.

Setting-up Exercises.—One of the very first things that a recruit must do when he enters the army is to take special exercises, called setting-up exercises, which will train him to hold his body properly. It would be



Fig. 16 a.

Fig. 16.—Setting-up exercises, No. I.

(a) Arms upward bend. First, third, and fifth positions.

(b) Arms outward extend. Second position.

(c) Arms upward extend. Fourth position.

(d) Arms backward and downward extend. Sixth position.

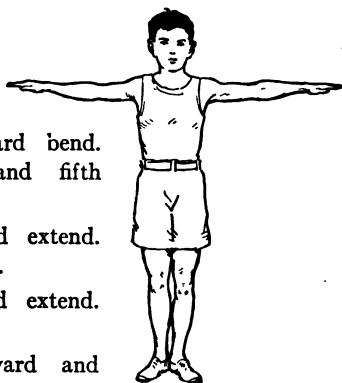


Fig. 16 b.



Fig. 16 c.

well for every one of us to take some simple exercises of this kind on getting up each morning. For a child of ten to twelve years of age, the following exercises are



Fig. 16 d.

recommended by Professor W. G. Anderson, Director of the Gymnasium at Yale University. More extensive exercises of a similar kind are described (p. 228) in a chapter by Mr. Walter Camp.

NUMBER I.—1. Arms upward bend. (Fig. 16a.)

2. Arms outward extend. (See Fig. 16b.)

3. Arms upward bend, as in first position.

4. Arms upward extend. (See Fig. 16c.)

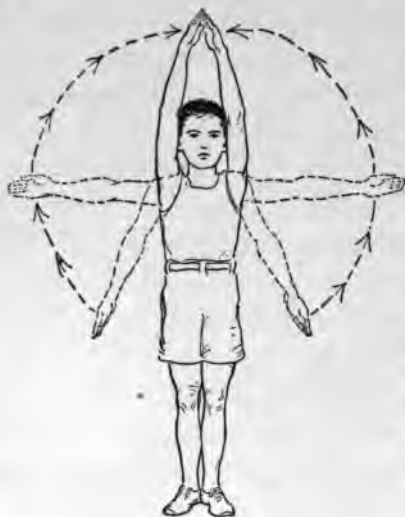


Fig. 17a.

Fig. 17.—Setting-up exercises, No. II.

- (a) First position.
- (b) Second position.
- (c) Third position.

tips back of the neck with elbows back. (See Fig. 17b.)

3. Raise the finger tips above the head again as in the first exercise and then force them backward, outward, and downward. (See Fig. 17c.)

5. Arms upward bend.

6. Arms backward and downward extend. (See Fig. 16d.)

NUMBER II.

1. Swing the arms slowly backward, sideways, and upward until the finger tips touch above the head. (See Fig. 17a.)

2. Bring the finger



Fig. 17b.



Fig. 17c.



Fig. 18a.



Fig. 18b.

Fig. 18.—Setting-up exercises, No. III: the swimming exercise.

(a) Second position. (b) Third position.

NUMBER III. THE SWIMMING EXERCISE.

1. Stand with the feet apart sideways and the body bent slightly forward, keeping the head raised and the eyes upward.
2. Bring the hands together in front of the waist, carry them upward and forward close to the body past the neck and face, and as far forward and upward as possible. (See Fig. 18a.)
3. Turn the palms outward, separate the hands, and swing the arms backward, outward, and downward, as a person does when he swims. (See Fig. 18b.)
4. Again let the finger tips meet in front of the waist.

Repeat this exercise five or six times. Take the movements slowly. Always keep the chest arched, the eyes up, and the head back a little.

Things that Prevent Us from Holding the Body Well. Sometimes a bent or deformed body is the result of bad habits of sitting, formed perhaps in school. See if the desk and seat at school are so arranged that you can sit comfortably at your work with your back straight. If not, ask the teacher if your seat cannot be changed or the chair raised or lowered. If your chair is too high or too near your desk, so that you have to bend your shoulders over or twist your body sideways to get at your work, it may do you real harm.

Tight clothing also is bad for the body. Shoes that are too tight, and shoes that have high heels, injure the foot itself and interfere with the proper carriage of the body as a whole. It was once the rule in China to bind up the feet of girl babies tightly so that they could not grow, and it is very sad to see the women walking unsteadily, on feet so small and misshapen they hardly look like feet at all. The Chinese of to-day have for the most part given up this horrible custom, and we ought to be as sensible as they and wear shoes that are big enough to let our feet develop properly.

The Story of the Young Prince and the Robber Children.—A story is told of a young prince who was once traveling with some of his courtiers to a distant city. The party was set upon in the forest by robbers, who killed all the attendants and carried off the prince as a prisoner. They took off his fine clothing and made

him pile wood and carry water and do the rest of the work of the camp, just as their own children did.

The governor of the city heard from people in the forest about the kidnapping, and he sent out soldiers, who drove off the robbers and brought all the children



Fig. 19.—The young prince is identified among the robber children by the kingly carriage of his body.

in the camp to the governor's palace. The young prince told the soldiers who he was and thanked them for rescuing him. The robbers' children, however, were as bad as their parents. As soon as the real prince had spoken, one of them cried out, "That is not true. He is not the prince. I am the prince." And another said, "No, *I* am the prince;" and another, and another.

Prince and all were dirty and clothed in rags. No one in this city had seen the prince since he was a baby, and the soldiers were much puzzled to know what to do.

The governor of the city, however, was an old man and very wise. He had *all* the would-be princes brought before him. After looking at them all for a moment, he went up to the real prince and said, "Your Highness, I know that you are the prince because you hold yourself like a king; and I know that these others are the children of the robbers because they slouch and crouch like thieves, as they are."

If you were kidnapped, as the prince was, could any one tell you from one of the robber children by the way you hold yourself?

QUESTIONS FOR DISCUSSION AND REVIEW

1. Of what use are the bones in your body?
2. What kinds of animals can you think of that have their skeletons on the outside? What kinds, that have their skeletons inside their bodies, as we do?
3. What is one reason why the habit of drinking milk is a good one for children to form?
4. Name the principal parts of the skeleton.
5. What difference is there between the movements of the arm at your shoulder and the movements of your lower arm at the elbow when you keep your upper arm still?
6. How is the backbone made up?
7. What bones move when you breathe deeply?
8. What are some of the important differences between the bones of the skull and those of the arms?
9. What are the principal things to remember about holding the body well when standing? When sitting?

10. Eleanor thought a great deal about her clothes and always wore shoes that were too small for her; but she never thought much about holding her body well. Clara was not vain; she wore sensible shoes, and exercised every morning. There was a play at the school and one of these girls was to play the part of a princess in it. Tell which one you think was chosen, and explain why.

12. Tell the story of the prince and the robber children. What lesson does it teach?

CHAPTER IV

HOW THE PARTS OF OUR BODY MOVE

The Muscles and How They Do Their Work.—You have learned in Chapter II that the organs which move the different parts of the body are called muscles. You have learned, too, that a muscle is joined to two bones or other hard parts of the body, and that when the muscle shortens, it brings nearer together the two parts to which it is fastened.

Suppose that you have a short but very wide and strong rubber band, and that you fasten it at one end to a shutter and at the other end to the wall of the house. The band would shorten and pull the shutter in toward the wall. This is an illustration of the general way in which a muscle acts. The rubber band, however, would pull on the shutter all the time, while our muscles shorten and pull only when it is necessary that some movement should take place.

The way in which the muscle bends the arm at the elbow is shown in Fig. 20. This big muscle, which is called the **biceps muscle**, runs from the shoulder down the length of the upper arm and is fastened to the upper part of the forearm just below the elbow. The muscle is shaped like a spindle, and when the arm is straight, it is stretched out and loose. When you bend your arm, it becomes short and thick, as an elastic

band does when it shortens or contracts. Since the ends of the muscle are fixed to the shoulder and the forearm, this shortening tends to pull the bone in the forearm toward the shoulder. Press your left hand tightly on the upper part of your right arm. Bend your right arm slowly up, and if you have well-developed muscles, you can feel the biceps muscle thicken and swell up.

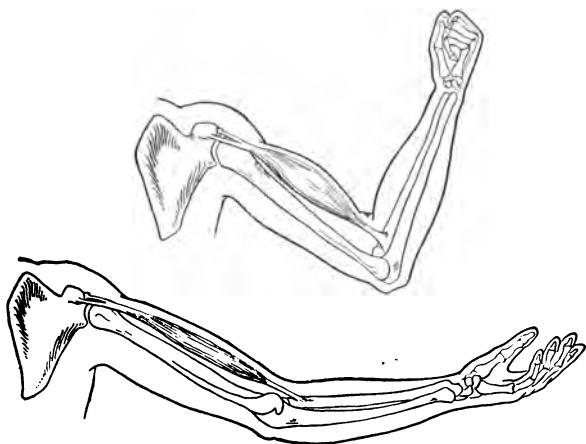


Fig. 20.—How the biceps muscle bends the arm.

The muscles are in many cases fastened to the bones, or other parts which they move, by strong bands called **tendons**. In the drumstick of a chicken you can see the tough whitish tendons which connect the muscle with the bone at its lower end; and the meat of the drumstick above, like all other kinds of lean meat that we eat, is the muscle itself.

Different Kinds of Muscles.—There are hundreds of different muscles in the body, and all together they

make up about half its weight. They differ very much among themselves in shape and size, according to the special work they have to do. The legs and the arms are almost solid masses of muscle, except for the bones inside, while the trunk is enclosed back and front in great sheets of muscle.

The muscles in the legs by which we make the movements of running and walking are large and powerful, but the biggest muscles of all are the ones in the back which men use when they lift heavy weights. One of these back muscles weighs several pounds.

Every flickering of an eyelid and every change in the expression of the face is brought about by the contraction of tiny muscles in the skin.

Our Unseen Servants.—Once upon a time there was a little girl who had an illness which lasted for years and kept her in bed so that she could not go out and play with other children. Her parents were wealthy, and she had everything that money could buy; but she never left her room and she rarely saw any one but her mother and her father and her nurse.

At last the doctor who was caring for this little girl succeeded in curing her so that she could walk about and was gaining strength every day. When she was allowed to come downstairs, you can imagine how interesting and exciting it was, after she had spent all those years in one room. You can imagine, too, how many surprising things she saw, things that would seem very natural to you, but to her were new and strange. One of these surprises came when she passed through a door

into a room containing a big black stove, with steam coming out of some pots which a tall, cheerful woman was stirring.

"Excuse me," said the child, "but what is this room and who are you?"

"This is the kitchen," replied the woman with a smile, "and I am the cook who prepares all your meals."

Just then a man with a big shovel walked through the kitchen. "Who is that?" whispered the child.

"That is the choreman who is going to attend to the furnace so that you may be all snug and warm upstairs."

There was a ring at the doorbell and a boy handed in some meat from the butcher's for dinner; and another left some tea and sugar; and another, some of the little girl's clothes from the laundry, all smooth and white.

She went upstairs to her mother, with her eyes shining with excitement, and cried out, "Oh, Mother, I never thought where all the things came from that I had in my little room upstairs. All the time the cook and the choreman and the butcher's boy and the grocer's boy were working for me, so that I might have all the things I needed."

Are not the muscles and other organs of the body somewhat like the cook and the choreman in this little girl's house, faithful servants working for us all the time without our realizing how much their service means? You can feel your biceps muscle as it bends the elbow. You can think of the movements of many other parts of the body which the muscles bring about,

and which they accomplish for you when you wish it. There are a great many other muscles, however, which work for you without any effort of your will at all; muscles whose action you could not stop even if you tried. The muscles used in breathing, for instance, contract about twenty times a minute, day and night, sleeping or waking, day after day, week after week, year after year. There are muscles in the walls of the blood vessels, muscles in the walls of the stomach, and in many other organs of the body. They are all necessary for the working of our body-machine, and, like the little girl who had been ill, we should be very grateful that we have such faithful servants to do all that is necessary for our good.

Strong Men of Old Times and of To-day.—In old times the Greeks used to tell many beautiful stories about great men with much more wisdom and power than real people have to-day. One of these great men, who was said to have done mighty deeds upon the earth, was named Hercules. According to the story, he was so strong that he could kill a lion with his hands. His most famous feat, however, was the securing of some wonderful apples made of gold. He traveled into far-off countries in search of these golden apples and at last found that the one person who could get them for him was the mighty giant Atlas. The Greek legend says that Atlas stood at the end of the earth with his feet in a forest and his head in the clouds, holding up the sky on his shoulders. Atlas was quite willing to get the apples, but what was to be done about the sky?

Why, Hercules could hold it on his own great shoulders, to be sure, while the giant strode over land and sea to the Garden of the Hesperides, where the apples were to



Fig. 21.—Hercules holding the sky on his shoulders, while the giant Atlas goes to pluck the Golden Apples of the Hesperides.

be found. So it was arranged; and although Hercules tottered a little and shook down a few stars, he held up the sky safely till Atlas came back. How Atlas was inclined to take a little vacation and leave Hercules in his place, and how Hercules got the sky off his own shoulders and on the giant's again, you must read some day

in a charming book by Nathaniel Hawthorne called *Tanglewood Tales*.

It is not only the Greeks who were fond of tales of strong men like Hercules. The peoples of Northern Europe had a god called Thor (from whom our Thursday or Thor's day is named), who did great deeds, killing evil beasts and bad giants with a mighty hammer. All nations have had their old-time heroes, men of strength and courage; and they were right in admiring them and telling about their doings so as to make other people want to be like them.

There are no giants and not many lions to be killed in our world to-day. There is, however, plenty of work to be done, which needs strength almost like that of Hercules and which is more useful to the world than the finding of golden apples. In war time men must still be ready to defend their country; and in peace there is work to do that is scarcely less important. The coal that is burned to keep us warm in winter, and to run locomotives and drive the machinery in factories, must be dug out of the mines by human muscle. In other mines men are getting out the iron from the earth. In the factories the iron is made into steel—the steel that builds our tall city buildings and our railroads and the great guns for our army. The tall buildings themselves must be built, and the railroads must be laid, and when they have been finished, the snorting locomotives must be driven over them, pulling their long trains of cars behind. The men who do these things must be strong in muscle, and they

must be brave as well as strong. It is no uncommon thing for the miner or the railroad engineer or the man who places the steel in a tall building to lose his life from a fall or an accident of some other kind.

How to Grow Strong.—Strength of body is a fine



Fig. 22.—Strong men and brave men are needed to-day to mine coal and iron, to make steel, to build railroads and tall buildings. The men in the picture are placing the steel for a “sky-scraper” in the City of New York.

thing if it is used, not to bully and take things by force, but to help and defend the weak and to do the heavy work of the world.

“Oh it is glorious
To have a giant’s strength; but tyrannous
To use it like a giant.”—SHAKESPEARE.

Every boy and girl owes it to our country to be as strong as he or she can, to develop all the muscles so as to be ready to do any work that may come, and ready to help the old and the ill who cannot do for themselves. Some people are naturally stronger than others, but we can all strengthen our muscles by **exercise**. When a muscle is unused, it becomes soft and flabby. When it is used, it grows more and more powerful. So by exercising, each one of us can grow stronger and more fit for useful service every day.

Many of us may not be called upon to do work that needs muscular strength and endurance; but we all have some work to do in the world, and success in any kind of work depends on being *well*. Exercising the muscles not only strengthens the muscles themselves but helps all the other parts of the body. When you run a race or take some other active exercise, you breathe more deeply, your heart beats faster, the blood flows more swiftly through the different organs, and after exercise your appetite is better and your sleep is sounder. Exercise is essential, then, not only for strength but also for the health of the body as a whole.

Good Kinds of Exercise.—Roller skating, bicycle riding, ice skating and coasting in winter, baseball, prisoners' base, and all sorts of running games, swimming, climbing trees, and long walks—these are the things that make the muscles grow strong and the cheeks rosy, and that keep the heart and the lungs in good condition.

Above all, games that children can play *together* are

good. Such games, in which one team challenges another team, not only develop physical strength but also teach you how to do your best, not for yourself but for the team, and to work side by side with others for a common end. Some one once said that the vic-



Fig. 23.—Outdoor play helps to make the body strong.

tory of Waterloo, the great battle in which the English defeated Napoleon, was won on the playing fields of Eton (a famous school where most of the English officers had studied when they were boys).

Keeping in Training.—If we want to be strong and well, we must not only do all we can to develop our bodies by exercise, but we must also avoid anything

that will directly harm them. There are many bad habits which may injure the health. Sitting up too late at night, eating too much or too little, and nibbling at candy between meals are examples of habits formed by children which have injurious effects upon the health and strength. As you grow older, you will learn that among grown people there is one habit of this kind that is more harmful than perhaps any other—the use of what are known as alcoholic drinks, such as whiskey, brandy, wine, ale, and beer. These drinks all contain a poison called alcohol, some of them having only a little of it, and others a great deal.

People who use alcoholic drinks are sure to be poisoned by them. It is important for every one to remember that the use of even a slight amount of alcohol makes people less able to do physical and mental work. Studies made by scientific men in recent years have proved this. Therefore, men who play football or row at college and have to be all the time at their best are never allowed to use alcoholic drinks, and according to the law of our country no such drinks can be served to any soldier or sailor in the uniform of the United States.

We can be sure that what is bad for the athlete and the soldier is bad for everyone else, and the safest rule for those who would keep strong and well is to use no drinks of this kind at any time.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Describe the way in which the biceps muscle does its work.
2. What is a tendon? Where have you seen one?
3. What are some of the things done for you by the unseen servants inside your body?
4. What was the story told by the Greeks about Hercules?
5. Tell some of the ways in which strong men are useful in the world to-day.
6. George and Albert and their little sister Jennie lived in the country. George liked to ride the farm horses and to swim in the creek, but Albert was lazy and spent most of his time whittling or playing marbles. One day when they were all three walking by the bank of the river, Jennie went too near the edge and fell into the swift, deep water. Tell what you think happened next.
7. What games are you fondest of? Which of these games do you think help most to make strong, fine men and women?
8. What is meant by the saying that the battle of Waterloo was won on the playing fields of Eton (see p. 53)?
9. Why were college athletes not allowed to use alcoholic drinks?
10. Why were the same rules applied to soldiers?

CHAPTER V

THE TELEPHONE SYSTEM OF THE BODY

How Messages Travel in the Body.—Reach out your finger and touch something on your desk or on the table near you; then think a little about what must have been going on in your body to make that simple movement possible. You will say you moved your own finger; but *how* did you do it?

You have learned that the actual movement of the finger was the result of the action of muscles in the finger itself and of others in the hand and arm. If you studied Chapter II carefully, you will remember, too, that the muscles contracted because a message was sent out through a slender thread called a **nerve**. The nerve carries such messages very much as a telephone wire carries messages from one place to another. The nerves are to be found running all through the different organs of the body. They give the signal that sets one part or another in action.

There is another sort of message which must be carried in the body, the message which tells you what is going on in various parts of it. If, for instance, you prick your finger, you feel the pain. Perhaps you may think it would be better if there were no nerves in the body to bring in this particular kind of message. Think about it a little, however, and see if it is not a good

thing that, when any part of the body is hurt, you feel a pain at once.

How the Parts of the Body Work Together.—Most of the movements we make, require the action not of a single muscle alone but of a number of different groups of muscles, which must all work together in just the right way. When you walk, a great many slight movements must be made to keep the body balanced. If you have ever watched a baby learning to walk, you will realize how difficult a task this really is. When you run fast, you will notice that your breathing becomes deeper and that your heart beats faster. You will learn later why this is necessary. All such activities, which take place in perfect balance without your thinking of them at all, are brought about by messages going back and forth in the body along the nerves.

In old times when a general was fighting a battle, the only way in which he knew what was going on in different parts of the field was by watching from a hill-side. He received news of more distant places from messengers who would come galloping up, their horses dripping with foam. Often a battle was lost because news of some sudden attack of the enemy came too late to send reinforcements to the spot. To-day every part of the battle line is connected with the general's Headquarters by field telephones, so that the whole army can work together as a unit to advance here or give way there, as the progress of the battle demands.

The nerves serve the body much as this telephone

system serves the army, making it possible for all its parts to work together for the common good.



Fig. 24.—A field telephone by which the various parts of an army may be kept working harmoniously together.

The Brain and the Spinal Cord.—All the messages from the army field telephone system we have been thinking about, come in at last to Headquarters, where the commanding officer sits and directs the whole battle.

The Headquarters for the human body is the **brain**, and it is from the brain that the messages go out when you make up your mind to do something and then do it. This important organ is a mass of living matter which fills the skull. Large bundles of nerves come into it from the eyes, the nose, and the ears. It is connected with the organs in the lower part of the body by means of the **spinal cord**, a thick cord of substance much like that in the brain itself. The spinal cord extends down through the center of the backbone (which is also called the spinal column). The backbone, you remember, is made up of bones shaped like rings, and it is through the centers of these rings that the spinal cord passes. All along its course, bundles of nerves enter it from the various organs of the body.

Reflex Actions.—In order to understand a little better how the nervous machinery of the body works, let us consider what happens in one particular case. Suppose a hot dish just out of the oven is placed on the table and you reach out to take hold of it. As soon as you touch the plate, you feel it is hot; but before you have time to think about it at all, you draw your hand quickly away. How was this action brought about?

In the first place, a message came over a nerve from the tip of the finger that touched the hot dish, bringing *in* the news that something was wrong. In the spinal cord the news was passed along until it reached the nerve going *out* to the muscles of your arm. This nerve sent out word to these muscles to contract and pull your arm away. There are always two parts to such

an action, which is called a **reflex action**. First, a message comes in, telling of something that has happened outside. Second, another message goes out and starts an action that will save some part of the body from harm or discomfort.

The particular reflex we have been speaking about does not have to be learned. Any child will draw its hand away from something that is hot. There are

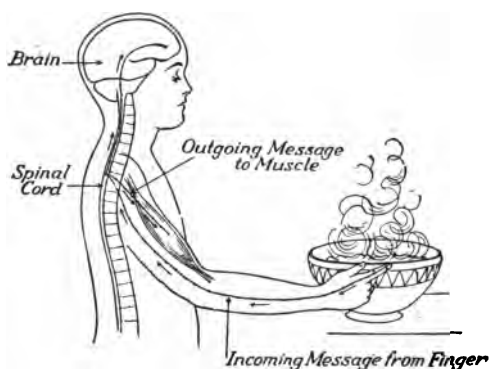


Fig. 25.—How the nerve messages travel in a reflex action.

many other reflex actions which must be learned by practice, but which, once they are mastered, become natural and easy. You have perhaps learned to skate on roller skates or ice skates, or to ride a bicycle. You remember that at first it was very difficult to do these things. You could not skate, for instance, more than a few steps without falling down or holding some one's hand. Gradually it became easier and easier, and now perhaps you can skate off without thinking about it at all. It is just as easy as walking.

Learning to skate is really learning to balance yourself. When you bend or lean too far forward or sideways, you save yourself by an unconscious movement the other way. Every movement of this kind is a reflex action. You train the nerves by practice so that when a message comes in that the body is bending too far, the order will go out, quick as a flash, to the right group of muscles. These muscles will act so as to swing out the arm or leg, or to bend the body forward or backward just enough to get in balance again.

There is one other kind of nervous action that you ought to understand, and one other long word that you must learn, the word **inhibition**. Reflex actions are not always useful; sometimes they must be checked or controlled. Suppose the hot plate we have been thinking about was not too hot for you to pick it up, but was hot enough to be quite uncomfortable after you had carried it halfway across the room. As the heat got into the fingers, some children by a simple reflex action would drop the plate on the floor and break it. I hope you would not drop it, however. You would check the reflex if you could, and stand the pain till you had put the plate down in some safe place. In such a case, the nerve message telling the muscles to drop the plate would be overruled by another message from your central nervous system saying, "Stop! Don't do it. We can hold on a little longer." Such an *order to stop* is an inhibition.

Inhibitions are usually hard at first, but they can be learned by practice. Some children, for instance,

have the habit of picking at their lips or their fingers or any place that has been cut or bruised. If they try, however, they can soon learn not to do this unsightly and dangerous thing. They can form an inhibition which, after a time, will keep their fingers away from



Fig. 26.—What habits, good or bad, do you think these two girls have formed, judging by what you can see in the pictures?

such places, as naturally and unconsciously as if they had never had the bad habit at all.

Good and Bad Habits.—Most of the things you do, from the time you get up in the morning till you go to bed at night, are done by unconscious habit, by reflexes and inhibitions which have been trained by practice. You do not have to make up your mind to put your clothes on in the morning or to brush your hair (I hope). You just do these things without thinking about them at all. You do not have to wonder how to get to school.

You walk down the familiar streets without a moment's hesitation.

Since habit plays so large a part in our lives—grown-ups as well as children—it is very important indeed to form good habits and not bad ones. One girl may be always cheerful and pleasant, another cross and disagreeable. One boy may be courteous and considerate,



Fig. 27.—Which of these two boys do you think will grow up to be the more useful citizen?

another rough and rude. It is all a matter of the kind of reflexes and inhibitions they have practiced. It is just as easy for most people to be cheerful and polite as cross and grouchy; the difference is merely in the habits they have formed. A child who has by practice learned to be punctual and obedient is just that much better off than one who has not; just as a child who has learned to ride a bicycle and skate is better off than one who can only walk and run.

Truthfulness is a habit; courage is a habit; unselfishness is a habit. All through our lives happiness and

success for ourselves and those about us depend very largely on whether we have formed in youth the habit of being honest and brave and kind. You know that a soldier cannot be sent into battle until he has been trained; and this training means not only making the muscles strong and fit, but much more. It means learning habits of neatness, punctuality, obedience, courage, and self-sacrifice. Every boy or girl who wants to serve our country can be training himself or herself now by forming the habits which will make a good citizen in the days to come.

The Story of the Boy Who Walked around Mont St. Michel.—In France there is a high and very steep rock with a church on the top of it, called Mont St. Michel. Once upon a time when bitter wars were going on, this rock was captured by the enemy, and the leader of the invading army made his headquarters in the chapel on its top. Here he ordered brought to him the citizens who had been taken prisoners, and among them one of the principal men of the village, M. de Bretteville and his little son, Louis. The cruel captain threatened to have de Bretteville thrown from the wall over the rock to punish him for his loyalty to his own people and to his religion, for this was a war between people of different religious beliefs. De Bretteville would not yield, and neither he nor his brave son showed any fear.

"I have a good mind to throw you after him," said the captain to the boy.

"You would not make me a coward if you did," said

Louis, "and I would gladly leap off the wall myself if I could save my father's life by doing it."

One of the other officers whispered something to the captain, and he turned quickly to the boy. "We will see how brave you really are," he said. "There is a narrow ledge of rock outside the wall. If you can walk around the rock on that ledge, I will set both you and your father free."

"No, no," cried de Bretteville, "I will not have it. I would rather a hundred times be killed myself."

"It shall be so, whether you like or not," replied the captain, "or I will have both you and the boy thrown over."

"Will my father be freed if I make the attempt, whether I get round safely or not?" asked Louis.

"He will; you have my word on that."

"Then I am ready," said Louis. He took off his shoes and stockings and was lifted over the wall so that he stood on the narrow ledge outside, with hundreds of feet of steep jagged cliffs below. The shelf of rock on which he had to walk was in places only a few inches wide, and he could keep from falling only by clinging to bits of projecting stone or roots and branches of bushes growing between the rocks. Step by step he made his way onward, never looking downward into the terrible chasm, but carefully and skilfully selecting the places to put his feet and to hold on with his hands. Even the soldiers watched every step with eager anxiety, hoping that the brave lad would succeed—and perhaps

you can imagine the suffering of his father while the minutes slowly passed.

Louis came at last to a place where there seemed no



hope of getting farther, for the ledge became narrower and narrower and he could see that ahead it disappeared entirely, leaving nothing but a smooth wall of rock. To turn back was impossible, for he was already on a ledge only a few inches wide.

Slowly and carefully the boy looked downward along the face of the cliff. About three feet below, he saw a jutting point of rock from which another ledge extended on around the corner of

Fig. 28.—How Louis walked round the wall at Mont St. Michel.

the cliff. He measured with his eye the distance downward and forward, saw that there was a holly bush growing out from the rock just at a good place to give a handhold,—and then he jumped. He landed safely with his feet on the ledge and the holly branches in his hand. The rest of the way was easier, and at last, after

what had seemed like a year, but was really only fifteen minutes, Louis was again clasped in his father's arms. They were both saved, saved by the courage and devotion of a boy.

I always remember Louis de Bretteville and the cliffs of Mont St. Michel when I think of habits. It was the habit of strong muscles and well-trained nerves, and above all the habit of coolness and courage and the habit of loving service, that made it possible for him to do this splendid deed.

Rest and Sleep.—The nerves and the brain require rest, just as any other part of the body does. If you try to concentrate on one thing too long, you soon become tired, and your work should be arranged so that this will not happen. Short periods of hard work, with rest or play or some other kind of occupation between, will enable a child to accomplish most in the long run.

The most complete kind of rest we can get is that which we find in sleep. A child of your age should have about ten hours of sleep each night. If you do not get this much on account of late evening work or play, you are pretty sure to suffer from it in the end.

Alcohol and the Nervous System.—Something was said in the last chapter about the effect of alcohol upon muscular work. Those who want to excel at physical games must avoid alcohol, but alcoholic drinks are even more harmful to the nerves than to the muscles. In fact, the reason why alcohol interferes with running or jumping or any other athletic exercise is probably more

because it affects the nerves which control the muscles than because it hurts the muscles themselves.

Alcohol interferes particularly with the inhibitions, so that even when it is used in very slight quantities, the reflexes are slower, the body is more clumsy and the mind more cloudy. People who use it in considerable amounts say and do things they would never think of saying or doing if they had not taken alcohol.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Tell what happens in the body when you pick up a pencil from your desk in school.
2. Sometimes the nerves become diseased so that they do not bring in messages of pain when some part of the body is injured. What serious harm might happen to a person who had such a disease as this?
3. What part of the body is like the field telephone used in the army?
4. What is the brain and what is the spinal cord? Tell where each is located in the body.
5. John stepped into his bath one morning and found the water very cold. He jumped out again almost as soon as his feet touched the water. What went on inside his body?
6. What reflex actions can you think of, besides the ones described on page 59 and in Question 5?
7. Why does it get easier and easier to ride a bicycle as you practice more and more?
8. The boy mentioned in Question 5 knew that a cold bath was really good for him. So after drawing back at first, he forced himself to get into the cold water and splashed about and had a fine time. How did he control the reflex that made him jump out first? What is such a control called?

9. What is a habit? Make a list, first of all the good habits, and then of all the bad habits you can think of.

10. Tell in your own words the story of the boy who walked round Mont St. Michel. Why was Louis able to do what he did?

11. Why do we need sleep? Keep a record of your bedtimes and getting-up times for the next week and see how much sleep you are getting.

12. What is the effect of alcohol upon the nervous system?

CHAPTER VI

HOW WE LEARN ABOUT THE WORLD OUTSIDE

Spying Out the Enemy.—In war, men are sent up in airplanes as observers, to find out what is going on behind the lines of the enemy. These airplanes have been called the eyes of the army and the navy. They are compared to our eyes, because it is largely by means of the eyes that we find out what is happening in the world about us.

A great many of our actions are the direct result of something that is going on outside the body. You move toward the fire because the room is cold. You run out to the kitchen because there is a delicious smell of gingerbread or cookies there. You hurry to school because the bell is ringing for the last time.

How do you find out that the room is cold or that there is a good smell in the air or that the bell is sounding? Why, you feel the cold and smell the gingerbread and hear the bell, of course, you say. It is not quite a matter of course, however; it is one of the most remarkable things about the human body—this power of finding out what is going on in the world about us. Try to think how many different ways you have of finding out what is happening, and what the different objects in the room are really like.

The Story of Helen Keller.—We can understand better the importance of this power of learning what

is going on about us by thinking of the true story of a little girl—now a grown woman—named Helen Keller. When Helen was less than two years old, she had a terrible illness which left her without the power of seeing or hearing or speaking. She could smell the flowers in the garden, but she did not know what they

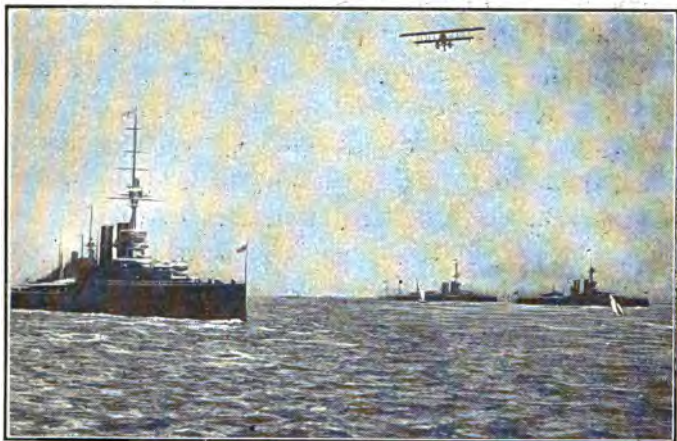


Fig. 29.—Airplanes are called the eyes of the army and the navy.

looked like. She could feel the jar of the shutting of a door and the shaking of the floor made by footsteps, but she could not hear a voice. She clung to her mother's dress as her mother went about her work, and learned many things by the sense of feeling. She found that a shake of the head meant "No" and a nod "Yes"; that a pull meant "Come" and a push "Go." She learned that other people did not communicate in this way, but did something with their lips, for her fingers could feel the movements of her mother's lips. But

she tried in vain to make some sound by moving her own lips. She learned to do little things about the house, and at five she could fold and put away the clean clothes when they came home from the laundry and pick out her own clothes from the rest. As she grew older, however, the sense of being unable to express anything except by the simplest signs became almost unbearable. She felt as if she were shut up in a prison.

When Helen was seven years old, her parents found for her a teacher from a school for the deaf and dumb in Boston. The deaf and dumb have a language by which they talk to one another by signs made with the fingers. This teacher, Miss Sullivan, after playing with Helen's doll for a little while, spelled out into her hand the letters d-o-l-l in this sign language. Helen quickly learned to make these movements, though she had no idea at first that they meant anything at all. She learned to spell out other words; and at last one day when she felt the water from the pump running over her hand, and Miss Sullivan spelled the word w-a-t-e-r, she grasped the idea that everything had a name and that she could express the name by her fingers. By these movements of the fingers she could at last break down the wall between herself and all the world outside.

After this, Helen made rapid progress. She was soon able not only to talk by the finger language but to read books. There are books especially prepared for the blind, in which the letters are raised so that it is possible to feel their shapes. After some years Helen learned to speak. She did this by feeling the movements

of the tongue and lips of a person who was making the sound of a particular letter, and imitating the movements with her own lips and tongue. At last this girl



Fig. 30.—Helen Keller. As a girl, though deaf, dumb, and blind, she learned to talk and to read with her fingers and graduated from Radcliffe College.

made such wonderful progress that she succeeded in graduating from Radcliffe College. By the use of a typewriter, she wrote a book about her life and her education, a book which you must some day read, in order to realize what this blind and deaf girl accom-

plished and what a blessing you have in the possession of your powers of hearing and sight.

The Sense Organs.—The power of learning about things in the world around us depends on special organs at the ends of the nerves which are called the **sense organs**.

The most complicated of these sense organs are the eyes with which we **see** and the ears with which we **hear**. There are also special sense organs of **taste** in the tongue and of **smell** in the upper part of the nose. Organs of **touch**, and organs by which we feel **heat and cold**, are scattered all through the skin.

The Eyes and How We See with Them.—The eye itself is a sort of hollow ball set in the head, with a bundle of nerves running from it into the brain.

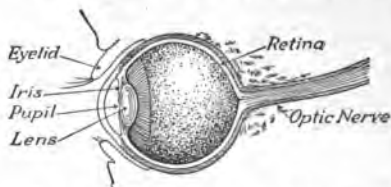


Fig. 31.—The structure of the eye.

At the front of the eyeball is a window, through which the light enters the eye. This window is the dark round opening in the middle of the eye, which is called the **pupil**. Around this window is a circular curtain, the **iris**, which is the colored ring you can see in a person's eye between the pupil and the white part outside.

If you will look at the eyes of a person who has been in a dark room, you will find the iris is only a narrow band and the pupil is quite large. On the other hand, if one has been out in the bright sun, the iris will be wide

and the pupil small. We need all the light in a dark place, so the iris curtain draws back to let in as much as possible. But in bright light the curtain closes around the pupil, so that the eye will not be injured by too much glare.

Just behind the iris is a part of the eye called the **lens**. This is made of a substance like glass, which makes a picture—of whatever you look at—on the extreme back of the eye, the **retina**. You have probably seen a stereopticon or magic lantern, and you know that the glass lenses inside it throw on a screen a big picture of the slide that has been put behind the lenses. In a similar way, the lens in the eye makes upon the retina a little picture of the part of the room in front of you. From the retina, the nerves carry to the brain messages telling about what you see.

Helping the Eyes to do Their Work Well.—The eyes are delicate and complicated organs and very often they do not do their work quite perfectly.

Many children have poor eyesight, without knowing it. They may be able to read a book well, but the writing on the blackboard seems blurred. Such children are called **near-sighted**; they can see things well that are close to their eyes but not things that are far off. Other children, called **far-sighted**, can see well across the room, but their eyes hurt when they read or sew. Often children are backward in their studies and are perhaps thought to be stupid, when really the trouble is only with their eyesight.

If the eyes do not see clearly, there is a constant

strain on them. The result is often a headache and sometimes indigestion and other troubles that you would never think had anything to do with the eyes at all.

If the writing on the blackboard looks blurred, your

O F L C

A P E O R

N P R T V Z B

Fig. 32.—See whether you can read the upper line when some one holds the book up 30 feet away, the middle line 20 feet away, the lower line 15 feet away. If you cannot, you need glasses.

eyes must be at fault. If you have to hold a book very close to your eyes when you read, there is something wrong. If your eyes hurt after you have been reading for a while, if your eyes are red and inflamed, or if you have many headaches, there is probably something the matter with your eyes. You should have them examined at once by a physician trained in this

work. If he finds anything wrong, he will fit you with eyeglasses, which will make up for the defects of your eyesight and enable you to see clearly.

It is quite wonderful what the effects of eyeglasses are on the children who need them (and at least one child out of every five does need glasses). The books and the blackboard come out clearly; discomfort and headaches vanish. Often a child who was dull in the schoolroom and listless on the playground becomes one of the best pupils and one of the jolliest children in the school.

Keeping the Eyes in Good Condition.—Whether you wear glasses or not, it is very important to take good care of the eyes. Be sure that you do not injure them by using them in an improper way. Many children do serious harm to their eyesight by reading or sewing too long at a time, or by using the eyes in a dim light. In the late afternoon it is easy to go on reading without noticing how fast the light is failing, and the eyes may be seriously strained by this practice. It is harmful, too, to read by a flickering unsteady light or in a railroad train or street car where the print is constantly jiggling about.

Too bright a light may be just as harmful to the eyes as one that is too dim. One should always avoid facing toward a window or a lamp or sitting in such a position that there is a direct glare of sunlight on one's work or the pages of one's book.

The proper position in reading or sewing is to sit with the light coming from above over the left shoulder.

The book or work should be held about twelve inches away from the eyes. Lying down while you read brings an unnatural strain on the eyes.

The Ear and How We Hear.—The outer organ which we ordinarily speak of as the ear is just a sort of trumpet to catch the sound. The most important part of the ear is inside and quite out of sight. The ear



Fig. 33.—How the light should be placed and how you should hold your book when reading.

that we can see outside opens into a tube, at the end of which is a thin membrane, somewhat like a piece of paper, called the **ear drum**.

When a person speaks to you, or when some other noise is made, the air is set to moving in waves, like the waves that spread

over the surface of a pond when you throw a stone into it. These waves strike the ear drum and make it quiver, or vibrate, in a certain way. As the ear drum quivers, it sets up a similar movement in a liquid inside the ear itself. The movement of this liquid in turn affects the ends of nerves in the ear, which carry to the brain the messages that are called sounds.

Guarding against Diseases of the Ear.—From the

back of the throat there is a tube that runs up to the inside of the ear behind the ear drum. Sometimes when a person has a cold in the head, germs may work their way up from the throat through this tube into the middle ear, and painful disease and even deafness may result. Any stopped-up feeling or rumbling in the ears, earache, or a discharge from the ears is a sign that something is wrong. The doctor should be consulted at once before the trouble becomes serious.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Why are airplanes called "the eyes" of the army or the navy? Could they be called "the ears" of the army just as well?

2. Tell all the things you know about a banana. Then tell what organs in the body helped you to find out these things.

3. Who is Helen Keller? What has she done?

4. If your eyes were closed, how could you tell when some one opened the window of the schoolroom? Could you tell if your ears were stopped up, too? Suppose it were a cold day outside. Could you tell, then, if your eyes were closed and your ears stopped up?

5. Make a picture of the eye as it would look if it were cut in two.

6. What is the lens? What is the retina? What is the use of each?

7. What difference is there between the eye of a person who has been in a dark room and one who has been out in the bright sun? How is this difference caused?

8. Lucy always has a headache after reading for a long time. George can never make out clearly what the teacher writes on

the blackboard. What is the matter with each? What ought to be done about it?

9. What can you do to keep your eyes in good condition?

10. What is the ear drum? Of what use is it?

11. Susan had a bad cold and afterward an earache. What had probably happened?

CHAPTER VII

FUEL FOR THE BODY

The Energy in Foods.—We have learned in Chapter II that the body needs food to keep it going, just as an automobile needs gasoline or a locomotive needs fuel. The energy of the body, the strength which moves the arms and legs, keeps the heart beating and the other organs working—this energy all comes from the food. From the food, too, the body gets its heat, just as the heat of a house comes from the coal put into the furnace.

Children need food also to make the body grow bigger and stronger. Year by year, as the child grows up, his weight should increase, and the change in weight is a very good measure of his general health. The table on page 241 will help you to find out the number of pounds you ought to weigh.

Do you remember that the first thing Robinson Crusoe did was to swim out to the wreck and get some biscuits to eat and some bread and rice and cheese? Do you remember how he shot goats and gathered grapes to eat, and how glad he was when the barley he had planted came up so that he could make some bread? He knew that he could not keep alive on the desert island unless he provided food for himself.

The body gets a great deal of energy when we eat

certain kinds of food, while from others it can get very little. You would have to eat several whole tomatoes, for instance, before you could get as much energy as one lump of sugar would supply. The men and women who study foods and the food needs of the body have

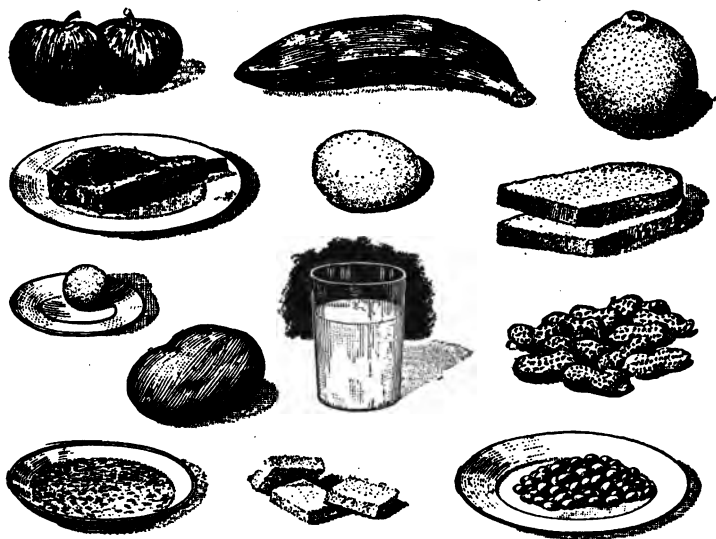


Fig. 34.—Each of the portions of food shown in the picture will give the body about the same amount of energy. They include: an ordinary serving of beans, 3 lumps of sugar, 1 large banana, 11 double peanuts, 1 large egg, 1 potato, 1 chop, 2 slices of bread, 1 orange, 2 apples, $\frac{2}{3}$ of a glass of milk, 1 pat of butter, and an average serving of oatmeal.

a way of measuring the amount of energy supplied by foods. They measure the energy of foods in *calories*; and they have arranged all the common foods in classes, according to the amount of energy they will supply.

The Importance of Different Kinds of Foods.—In order to be well and strong, it is not enough to have a certain total amount of food energy. We must have also a proper variety of foods. The body needs certain special things which we can get from some foods and



Fig. 35.—A group of New York schoolboys being served with luncheon in an experiment to determine the best diet which can be provided for a child at a given cost.

not from others. You could not keep healthy long if you lived on nothing but twenty dishes of cereal a day or twenty pats of butter or twenty potatoes, even though you might get the food energy you need.

There is a very important kind of food called **protein** (prō' tē in), which is found in eggs and meat and beans, but not in sugar or butter or cereals, and only to a slight extent in bread. You need a certain amount

of these protein foods. You need, also, lime and iron and other things which are found in fruits and vegetables, and to a less extent in cereals and meats. Milk is the most perfect food we have, for it contains all the different kinds of nourishment our bodies require. Every child should drink a pint or more of milk each day.

In addition to the ordinary liquid foods, such as milk, it is important to drink plenty of water, for the body needs an ample supply of water in order to keep in good health. Every child should drink at least three glasses of water a day, and more in hot weather.

Bering's Voyage into the Arctic.—Bering Sea, about which you will study in your geography, was named for a famous Arctic explorer, one of the adventurous men who sailed into the unknown northern seas to find out about the strange frozen countries near the North Pole. On June 4, 1741, he set out on one of these voyages of discovery in a ship called the *St. Peter*, with a crew of seventy men, and with another ship, the *St. Paul*, as a companion. On June 20, while they were running into the Gulf of Alaska, a heavy storm drove the *St. Paul* to the southward, and the *St. Peter*, after cruising about and waiting for a time, pushed on alone to the north. More heavy storms drove the ship two hundred miles out of its course, and October found Bering still in the neighborhood of the Aleutian Islands. As he once more tried to make his way north, he met a new difficulty. His men began to fall sick. The disease began with extreme weakness "making the victims spiritless and indifferent to everything, preferring

to lie down and die rather than to move about." Two deaths occurred, and at last Bering had to give up and return home with scarcely enough well men in the crew to sail the ship.

The disease from which these men suffered is called scurvy. We know to-day that it was caused by a very simple thing—by the fact that the diet of canned and



Fig. 36.—Explorers in the frozen North used to suffer severely from a disease called scurvy, which was due to the lack of fresh fruits and vegetables in their diet.

preserved foods on which these men lived, though it contained plenty of energy, was lacking in certain special things that are necessary to keep people well. Scurvy was a very common disease in old times, not only in the Arctic but on all long voyages in which fresh foods could not be obtained. On recent polar expeditions and on long sea voyages to-day, scurvy is practically

unknown, because fresh meat or vegetables or fruit juices are provided to supply the special kinds of foods that will prevent that disease.

Where Your Foods Come From.—Men in Florida and Oregon have planted orange groves and apple orchards that you may have fresh fruit for your breakfast. Others have cultivated oat fields in the Middle West, and still others have worked in the mills to prepare from the oats the cereal you need. Still others have grown the wheat and made the flour from which your bread was mixed. Sugar beets have been grown in Michigan, and dairy farms have been operated in your own state, that your cereal might be sweetened and your glass of milk kept full. Your cocoa may have been brought from South America, and your rice perhaps from Japan on the other side of the Pacific.

You need all these things, and many more, in order to keep healthy. You ought to try your best to learn to eat, and to like, all the different kinds of good foods that are brought into your home from the near and the distant regions of the earth.

An Ideal Diet.—Three good meals for a child of ten or twelve years of age would be about as follows:

A good breakfast would include:

1. Some fruit (an orange or an apple, a baked banana or stewed prunes).
2. A well cooked cereal (oatmeal is the best).
3. Two slices of toast or bread and butter.
4. A glass of milk.

A soft-boiled egg may be added, if desired.

For dinner there should be:

1. A helping of meat or fish or omelet or scrambled eggs.
2. A baked potato.
3. A helping of spinach, carrots, peas, or some other green vegetable.
4. Bread (not too fresh) or crackers and butter.
5. A glass of milk or a cup of cocoa.
6. A simple dessert (such as cornstarch pudding-junket, baked custard, or rice pudding).

A good supper would include:

1. A bowl of some thick soup, or milk toast.
2. A simple salad of fresh fruit or vegetables, if possible.
3. Bread and butter.
4. A baked apple or some stewed fruit.

Food Saving in War Time.—As a result of the ruin wrought in the fertile fields of France, Belgium, Russia, and Roumania by the great war and because so many millions of men have had to spend their time in defending their countries instead of cultivating the soil, the world supply of food has run very short in the last few years. We in the United States who had a surplus did our best, during the war, to save all the food we could for the people of Europe, who needed it so badly.

The habits we learned then are many of them habits that it will be good to keep up in peace times. During the war we tried particularly to save *wheat, meat, fat,*

and *sugar*, for these were the foods most needed by the people of Europe. It is still a good plan, for our own pocketbooks and for our own health, now that the war is over, to be careful not to waste any good food, such as scraps of bread or bits of meat and fat. It is a good



Fig. 37.—The wheat fields of America fed the French and the Belgians and the English as well as ourselves during the Great War.

thing to use fish and eggs and particularly milk instead of meat at some of our meals, to eat corn bread and potatoes sometimes in place of wheat bread, and to use no more butter and sugar than we really need.

Some Food Habits to be Avoided.—The digestive system of the body works best if we eat at regular

times. Meals should be served at the same hour every day, and no food should be taken except at mealtimes. Nibbling between meals is a bad habit. If a child is hungry in the middle of the morning, a glass of milk and some crackers may be made a regular fourth meal.

The bad food habit which children are most likely to form is the eating of too much of certain highly flavored foods—pickles, sweets, and the like. The result of this is that they have no appetite left for the good nourishing foods—bread, cereals, meat, milk, and vegetables.

Fried foods, rich fat meats, and pastry are bad for children, except in very small amounts. Tea, coffee, and other stimulants should of course be avoided. They may do harm to grown people, and they are very harmful for children.



Fig. 38.—Herbert C. Hoover, Food Administrator of the United States, who was in the charge of the campaign to save food for the starving people of Europe during the World War.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Why do you need food?
2. Look carefully at the pictures in Fig. 34 and see which of the foods shown there yield a given amount of energy from the smallest amount of food. Of which foods would you have to eat the most, to get a given amount of energy?
3. Why is milk a good food? How much milk should you drink each day? About how much *do* you drink each day?
4. Why did Bering have to turn back from his Arctic exploration? What do Arctic explorers do nowadays to avoid such difficulties?
5. Write down what you eat for breakfast, dinner, and supper for the next two or three days, and see how closely it corresponds with the list of foods on pages 86 and 87.
6. Why has the world been in such great need of food since the great war began? What should Americans do about it?
7. What should we eat instead of meat? Instead of wheat bread?
8. George is very fond of sweets and sucks a piece of candy every time he gets a chance. What do you suppose happens when George sits down at the dinner table? What do you think will be the effect on his health?

CHAPTER VIII

WHAT HAPPENS TO THE FOOD IN THE BODY

Preparing Food for the Body.—You eat a great many different kinds of foods during the day—liquid foods such as milk, soft foods such as cereals, and perhaps some quite hard foods like nuts or hard crackers. You know that in some way these foods supply the energy for your daily life and that they are even built up into the organs of your body. You are growing, year by year and month by month, and every part of your body is getting bigger. The food you eat supplies the material for this growth; but it is not at all an easy thing to change oatmeal and poached eggs and milk toast into the muscles and nerves of a boy or girl.

The food, after being swallowed, passes into a tube called the **alimentary canal**, and before it gets really into the blood where it can be used, it must pass through the walls of the alimentary canal. In order to do this, the food must all be changed to a liquid form.

This process of changing the food so that the body can use it is called **digestion**. It is brought about by the action of the **digestive juices**, which are liquids prepared in the walls of the alimentary canal and in special organs connected with it. These liquids have the power of changing the foods in such a way that

they can be passed through the walls of the alimentary canal and taken into the blood.

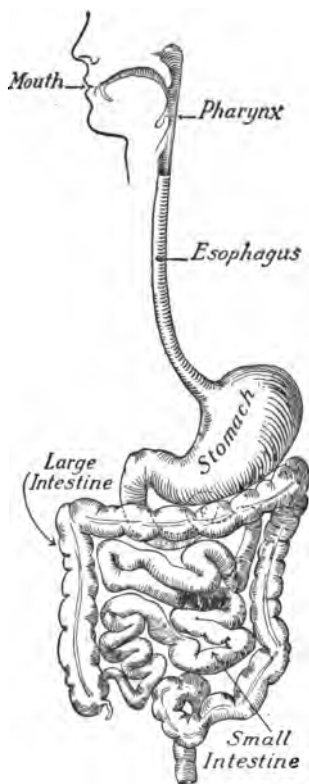


Fig. 39.—The alimentary canal and its principal parts.

The action of the digestive juices may be shown by a simple experiment. Take two glass test tubes, and in each put a piece of meat and a little water. To the second test tube add some of the digestive juice extracted from the stomach of a calf.¹ After the tubes have stood for half an hour in a warm place, the meat in the first tube will look just as it did at the beginning, but the tube containing the digestive juice will look cloudy and soft and the liquid will be discolored. This shows that the meat is being dissolved, or changed into liquid form, by the digestive juice.

You can easily observe the action of one of the digestive juices in your own body. Chew a piece of bread very slowly and thoroughly and see if you can notice a change in taste. While you chew, a digestive juice in the mouth becomes mixed

¹ A solution of pepsin and two per cent hydrochloric acid.

with the bread. The starch in the bread is changed to sugar by the juice. Do you not notice that the bread tastes sweeter as this change takes place?

Parts of the Alimentary Canal.—The different parts of the alimentary canal are so important that you ought to learn the names of the principal ones, even though some of these names are long and hard to remember.



Fig. 40.—The size of a child's stomach.

The general arrangement of the parts of the alimentary canal is shown in Fig. 39. The food, after it is swallowed, passes first down a long slender tube called the **esophagus** into a large bag or sac called the **stomach**. From the stomach, the food passes gradually out into a long coiled tube, the **small intestine**, and from there into a larger tube, the **large intestine**.

Digestion in the Mouth.—Two important steps in the process of digestion are taken in the mouth before the food is swallowed. First of all, it is broken up and softened by the action of the teeth. Secondly, it is mixed with the digestive juice of the mouth, which begins the digestion of the food by changing the starch in it to sugar.

It is very important to chew the food thoroughly before it is swallowed, if the rest of the digestive system is to be kept in good working order. The stomach is meant to digest soft, well chewed pulp, and if solid

food is forced down in lumps, there is likely to be trouble. You remember, from Æsop's fable that was discussed in the second chapter of this book, how the stomach depends on the other organs of the body to help it in its work. One of the principal things it depends upon is the vigorous and thorough action of the teeth upon the food that is to be sent down to it for digestion.

Another reason, though a less important one, for thorough chewing of the food is the fact that the food tastes much better and we enjoy it more if it is eaten in this way. If you have been in the habit of bolting your food, at your next meal try eating it quite slowly and chewing it thoroughly. See if you do not get more pleasure out of it.

Digestion in the Stomach.—The stomach is so large in comparison with other parts of the alimentary canal that it serves as a sort of storehouse for food. We need such a storehouse because the food, eaten in large amounts at mealtimes, must be digested slowly. It passes gradually from the stomach to the intestines. But though the storehouse is large, it cannot store the food of an over-hearty meal without making trouble.

In the walls of the stomach, there are strong muscles. These muscles, by contracting, keep the food moving round and round so as to break it up into a thin paste. At the same time more digestive juices are added to the food (particularly the kind of juices that dissolve meat, as shown in the experiment described on page 92).

After the food has been churned up in this way, and the digestive juices have acted upon it for a time, it

is squeezed out from the stomach into the small intestine. The last of the food taken at an ordinary meal passes out of the stomach and into the intestine about four hours after it is eaten.

Digestion in the Intestines.—We have seen how necessary the stomach is as an organ of digestion. The small intestine plays an even more important part in the process. This portion of the alimentary canal is slender, but it is very long. The food takes ten or twenty hours to pass through it.

In the course of its passage through the small intestine, the food mass is mixed with more digestive juices. Some of these juices come from the walls of the intestine itself. Some come from two organs, the liver and the **pancreas**, which pour them into the intestine. By the time the food has passed through the small intestine, most of the digestible matter in it has been changed into a liquid form.

Meanwhile the digested foods are being absorbed, or taken in, through the walls of the alimentary canal into the blood in the blood vessels. On one side of the thin wall of the alimentary canal is the food, now digested and made liquid. On the other side of this wall is the blood. The food passes through the wall into the blood by a process called **absorption**. As the small intestine is very long, there is ample time for all the digested food to be absorbed there.

In the large intestine there is little more that needs to be done, except to store the undigested waste material until it is discharged,

The Wastes of the Body.—There are two kinds of wastes that must be regularly gotten rid of by the body. One kind is the undigested material from the alimentary canal. The other wastes are formed in the organs themselves in the course of their daily activity. Some of the



Fig. 41.—A calm and happy frame of mind helps to make digestion easy.

wastes of this second kind are discharged into the air which we breathe out. Some are discharged in the perspiration formed by the skin. Some are discharged into the alimentary canal by the **liver**, a large organ which lies just above the stomach and empties into the small intestine; and the rest are gotten rid of by way of the **kidneys**.

The kidneys are two bean-shaped organs which take

out water and certain waste materials from the blood and discharge them into a pouch called the **bladder**. The fluid formed by the kidneys is called the **urine**. The bladder should be emptied about six times a day.

Keeping the Digestion in Good Working Order.—If the digestive machinery is to be kept in good working order, it is of course necessary that it should not be supplied with too much food or with the wrong kind of food. It is also important not to exercise violently just after eating, for that prevents the digestive machinery from working properly. A cheerful, pleasant frame of mind helps to make digestion easy. Mealtimes should be times for pleasant talk and leisurely enjoyment, not for the hurried snatching of a bolted meal.

Another thing that is very important for the health of the digestive system and the body as a whole is the emptying of the large intestine by regular movements of the bowels. If the undigested food remains too long in the large intestine, it decays, and poisons are formed. These poisons may be absorbed into the body. A great many people have headaches and feel tired and half sick from this cause. A movement of the bowels at least once a day and at a regular time is one of the most useful health habits that can be formed.

QUESTIONS FOR DISCUSSION AND REVIEW

1. What is digestion? Why is digestion necessary?
2. When a person experiences pain or discomfort as a result of overeating, we call it indigestion. Why?
3. What do the digestive juices do? Give an example.

4. What are the principal parts of the alimentary canal?
5. Eleanor takes her time at the table, laughs and talks and chews her food thoroughly. Peter, who is generally late to meals, bolts his food and runs away as soon as possible. Which do you think will have the better digestion when they grow up? Why?
6. What processes of digestion go on in the mouth?
7. What can you learn from the picture on page 93 about the harmfulness of eating too much at one meal?
8. What happens to the food in the stomach?
9. What happens to the food in the small intestine?
10. Of what use is the liver?
11. What are some of the things that you can do to keep your digestion in good order?

CHAPTER IX

KEEPING THE TEETH IN GOOD CONDITION

The Uses of the Teeth.—Do you know what kind of teeth a dog or a cat has, and how they differ from the teeth of a cow or a horse?

The teeth of the dog and the cat are sharply pointed, so that they can be used for tearing and cutting. The teeth of the horse are flat and are made for grinding things into a pulp. In each case the teeth are of just the kind needed to work on the kind of food the animal eats. A dog lives chiefly on animal food, such as meat, which must be torn into shreds before it is swallowed. The horse, on the other hand, lives on oats, hay, and similar foods that do not need to be torn up, but must be ground into a fine pulp. We can generally tell what kind of food any animal eats by merely looking at its teeth.

Which kind of teeth do you have in your mouth? Look in the mirror, or pass your tongue over them, and you will see (or feel) that you have both kinds. This is just what might be expected, since you eat both animal foods and vegetable foods, like bread and cereals. In the front of your mouth are **cutting** teeth, not just like the pointed teeth of the dog, but having a long sharp edge which serves the same purpose; while at the back are flat teeth for **grinding**, which do the same sort of work as the teeth of the horse.

The teeth form a very important part of the digestive system, for unless the food is well broken up and mixed with the digestive juices of the mouth, it will reach the stomach in lumps and will be very hard to digest.

The First and Second Sets of Teeth.—There is one very curious thing about the teeth—and that is the fact

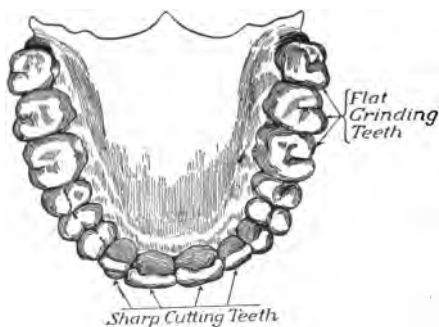


Fig. 42.—The arrangement of the permanent or second set of teeth.

that we have, each of us, two distinct sets of teeth, one for use as children and the other set for the rest of our lives.

A very little baby has no teeth that you can see, but just soft red gums. The teeth, however, are there down below the surface, though very small. Soon they begin to grow and push out through the gums. By the time a baby is two years old, it usually has all its first set of teeth—twenty of them—and these are the teeth a child uses till it is more than five years old.

At about the age of six years, the first teeth begin to loosen and come out; and soon after each one of the first set drops out, one or more of the second or permanent set of teeth grows in its place. There are thirty-two of these permanent teeth, and most of them grow out between the ages of six and twelve. The

last four teeth sometimes appear when a person is twenty years old or more. They are called the "wisdom teeth," because when one gets to be as old as twenty, one ought to be quite wise.

The Parts of the Tooth.—The part of the tooth that we see in the mouth is squarish or flattened, according to the kind, and is called the **crown**. It is covered with a very hard smooth substance, called **enamel**. Beneath the surfaces of the gum are the **roots**, which are pointed ends, one, two, or three to each tooth. The roots hold the teeth in place, somewhat as a root holds a plant firmly in the ground (see Fig. 43). The crown of the tooth is mostly hard dead matter, but in the roots there are nerves and other kinds of living tissue.



Fig. 43.—The parts of the teeth above and below the gum line.

The Value of Good Teeth.—A straight, clean, shining set of teeth is always pleasant to look at. It is also a help in keeping the whole body in good health. If the teeth are strong and sound, their work of preparing the food for digestion by thorough chewing is much more likely to be well done. When people grow old, the teeth often fall out and have to be replaced by false ones. The better care we take of our teeth, the longer we shall keep the ones that Nature gives us.

The Microbes and Tooth Decay.—The teeth seem so hard and strong that you might think they were the very last parts of the body likely to become diseased.

Yet, curiously enough, there are very few organs that give us so much trouble as our teeth.

Diseases of the teeth are usually caused by very tiny plants or animals called **microbes**, a word which means a little living thing. We shall learn more about microbes in Chapter XIV. They are very small indeed, so small that thousands of them could be on the point of a pin without your being able to see anything there at all, even with your sharp eyes. The microbes can be seen, however, with a special instrument called a **microscope**. You probably know what a magnifying glass is and how, by looking through it, you can see small things that would be quite invisible with the eye alone. A microscope is a very powerful magnifying glass; and by looking through such a glass at one of the bits of food left clinging between the teeth, you could see great numbers of microbes, such as are pictured on page 162.

In the food particles, these microbes grow and increase in numbers very rapidly. As they grow, they change the food and spoil it, so that it smells badly. The destruction of food or other substances by microbes is called **decay**. Some of the microbes that grow in food masses on the teeth form chemical poisons, which eat into and decay the hard enamel of the teeth themselves. In the little cavities that are produced in the teeth, more food gathers, and more microbes grow, and more chemical poisons are formed. These substances eat into the tooth deeper and deeper, until finally the poisons formed by the microbes, and perhaps even the microbes themselves, reach the living tissue inside the tooth.

It is unpleasant to think of having such things as this going on inside your mouth, and the results are quite as unpleasant as you might expect. Bad teeth often give the mouth a very disagreeable odor, even when the decay has only just begun. As the process goes on, the teeth become sensitive, and chewing is neglected, which of course is bad for the digestion. When decay reaches a certain point, real toothache begins, as a result of the work of the poisons formed by the microbes. If you have had a toothache, you know how painful it is; and if you have not, I hope you may never learn. Even the toothache is not always the worst of it. Sometimes the microbes get into the soft tissue at the root of the tooth, and the poisons which they form are carried by the blood all over the body. Or the microbes themselves may pass through the blood to the heart or some other organ. If this happens, serious and even fatal disease may follow. Microbes can grow in the mouth or in the intestines without doing any harm; but if they grow inside the organs of the body, they always cause illness. So you see that tooth decay may really be a very dangerous thing, and we ought to guard against it with every possible care.

Guarding against Tooth Decay.—The chewing of ordinary tough foods is good for the teeth. Vigorous use polishes their surfaces and keeps the muscles that move them in active condition. We should not, however, crack nuts or bite very hard objects, for that may chip off the enamel.

The most important precaution we can take against

the dangers of tooth decay is the regular use of the toothbrush. If the teeth are kept thoroughly clean, the microbes will never get a chance even to start their evil work.

The best possible thing to do is to brush the teeth carefully after each meal, so as to remove any bits of



Fig. 44.—How to hold the toothbrush.

food just as soon as they have collected. If we cannot always do this, we should brush the teeth at least twice a day, night and morning. The brush should be stiff, but not too hard. It should be applied systematically, not only to the flat tops of the teeth but to the fronts and backs as well.

Some people brush their teeth along the sides from the back to the front of the mouth, and some brush up and down, from the gums to the crowns of the teeth.

The best way of all is to hold the brush in the position shown in Fig. 44, press the bristles firmly against the teeth, and give the brush a slightly *rotary* (round and round) motion. When the outside surfaces at each side and in front have been well cleaned, the inner surfaces should be treated in the same way. Then the crowns of the teeth should be brushed thoroughly.

Finally, after the brushing has been completed, the mouth should be rinsed several times. You will find that you can do this by forcing water between and around the teeth with the aid of the lips and tongue.

The Brushes' Quarrel.—Once upon a time a little girl thought she was waked up one night by a noise of voices in the kitchen. It seemed to her that she pushed the kitchen door open softly and that this was what she saw and heard.

The moonlight was shining quite brightly through the kitchen window, and sitting in a ring on the floor were all the brushes and brooms in the house. They were having a vigorous argument as to which one ought to be king. The broom was presiding at the meeting, because he was biggest; but it had been agreed that the one that was most useful in the household ought to be the king, and each was presenting arguments why he should be the one.

The hearthbrush declared that ashes from the fireplace made more dirt in the house than everything else put together, and that his work of keeping them back on the hearth and preventing them from being blown about was the most important thing a brush could possibly do.

Mr. Broom, the chairman, put in his word. "There is nothing at all in the Hon. Mr. Hearthbrush's claim." (The broom was always very formal and polite.) "The open fires are only lighted in certain rooms and at certain times; but there is dirt in the house always and everywhere. I am the one who has to keep it clean

from attic to cellar, in July as well as in January, and my work is therefore most important of all."

The bottle brush and the sink brush applauded this (by rubbing their bristles against each other); but the clothesbrush jumped into the center of the circle, very much excited, and gave the discussion a somewhat new direction. "It is true that Temporary Chairman Broom probably moves more dirt in a year than all the rest of us put together," he said, "but I

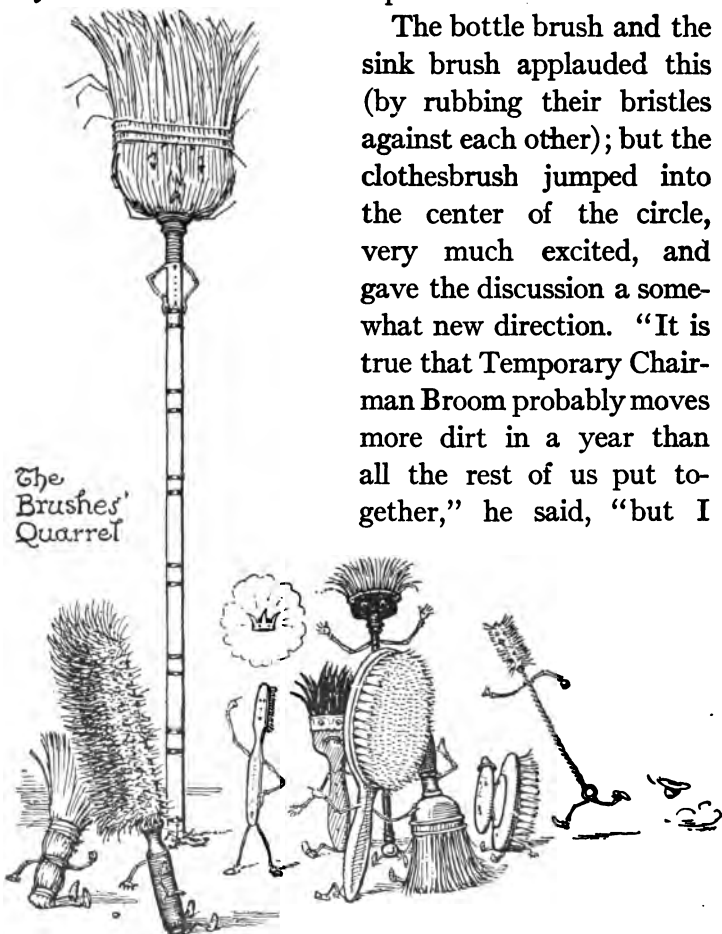


Fig. 45.—Should the toothbrush be king of all the brushes? claim it is *quality* of work, not *quantity*, that ought to count. Mr. Broom is trusted for the heavy work of

cleaning floors and stairways, but when they want a really good job done, when they want the clothes they wear to be spic-and-span, they call on me."

"There is a great deal in what Brother Clothesbrush has said," interrupted a handsome silver-mounted hairbrush, "but his argument counts much more for me than it does for himself. The clothes are more important than the carpets, but the head is more important than the clothes, and I have by far the greatest work of all to do."

There was silence for a moment, and it almost looked as if the hairbrush would carry the day. Suddenly a tiny little figure ran out into the moonlight, and a high squeaky voice cried out, "Wait a bit, wait a bit, until you have heard a plea from me, the Toothbrush. The clothes are more important than the carpet, and the head than the clothes, I agree. But the inside of the head is far more important than the outside."

"If Mr. Clothes Brush or Mr. Hairbrush is neglected," he went on, "our masters and mistresses will look untidy, but they will not get ill; while if I were not used, there would be toothache and misery and illness as a result. I am the one who ought to be king of the brushes."

There was a great hubbub and noise, some taking little Mr. Toothbrush's side and some opposing him; but just then the dreamer woke up and never knew who was finally chosen king.

The Dental Care of the Teeth.—The toothbrush is certainly one of our best friends, but even the regular

use of the toothbrush cannot be expected to defend the teeth completely from our microbe foes. Every now and then decay begins on a small scale, even in well-cared-for mouths. It is important that the teeth should be regularly examined by a dentist in order to detect this decay and treat it before it has gone too far. If the teeth are examined three or four times a year, they can be kept sound very easily and with no pain. The dentist can also straighten teeth that are crooked, which often improves a child's looks and his health very greatly. Early and frequent dental care before the teeth decay will spare many painful hours afterward. It is for this reason that most schools provide for the systematic examination of the teeth of the children, and there are few things that the school doctor and the school nurse do which are more important than this.

QUESTIONS FOR DISCUSSION AND REVIEW

1. What is the difference between the teeth of a cat and the teeth of a horse?
2. A deer eats grass. What kind of teeth do you think it has?
3. What kinds of teeth have you in your mouth? How many of each?
4. What is the crown of the tooth? What are the roots? Why is one part called a "crown" and the other a "root"?
5. What are some of the advantages in having a good set of teeth?
6. What are some of the things you can do to keep your teeth in good condition?
7. What are microbes? What do they do to the teeth?
8. George thought it was a bother to brush his teeth and he

never brushed them unless his mother was watching and told him to. What do you think happened in his mouth?

9. Describe the best way to brush the teeth.

10. Who do you think ought to have been chosen king of the brushes? Explain your choice.

11. Sally's mother took her to the dentist regularly three times a year. Jane never went except when she had a toothache. Which do you think spent more hours with the dentist?

CHAPTER X

BREATHING

The Importance of Breathing.—When some one has asked you what you were doing, you have probably often answered, “Nothing.” That was not quite accurate, however, was it? There are some things you are doing all the time, and one of the most important of these is **breathing**.

In and out, in and out, the air goes every minute of the day and night, whether you are working or playing or sitting still or asleep in bed. Put a watch on the table before you, and count the number of breaths you take in one minute. Then multiply the number by 60 to see how many times you breathe in an hour, and multiply that product by 24 to see how many times you breathe in a day. All through your life this must go on. If breathing stopped for a very few minutes, the whole machinery of the body would stop too.

The Organs of Breathing.—Where does the air go that you breathe in so many times a minute? If you will look at Fig. 46, you will see.

The air, drawn in through the nose, passes first into the upper part of the throat, for the nose opens into the throat, as you can see by the picture. From the lower part of the throat there are two openings. Through the opening at the front, the air is drawn into

the **windpipe**; and at the back there is an opening into the esophagus, by which food passes to the alimentary canal. The windpipe (see Fig. 47) runs down a little way and then divides into two branches, called **bronchi**, which lead to the **lungs**. The two

lungs are the principal organs of breathing, or **respiration**. It is through the nose, throat, and windpipe that the air we breathe passes down into the lungs.

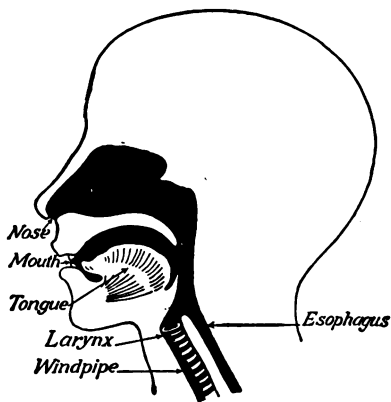


Fig. 46.—How the air passes from the nose to the windpipe.

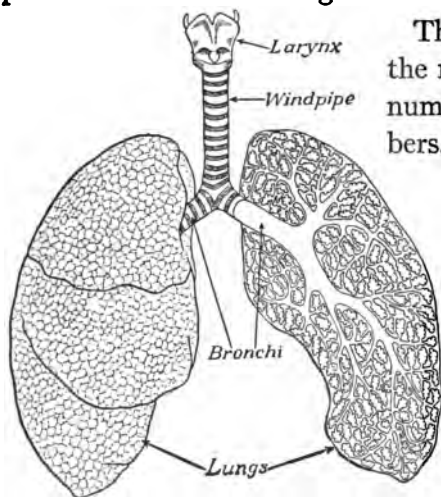


Fig. 47.—The lungs and the windpipe.

The lung is made up, for the most part, of a great number of small air chambers. All of these chambers are connected with the windpipe. You have just seen that the windpipe is divided into two bronchi; these two bronchi subdivide again into many fine branches that go to all parts of the lungs.

In the walls of the branches and of the tiny air chambers is a network of fine blood vessels. The blood flowing through these blood vessels is separated from the air in the lung by a very thin layer of living matter. Through this thin layer, substances in the air may pass into the blood, and substances in the blood may pass out to the air.

The Air We Breathe.—What is there in the air that the body needs?

The air seems like nothing at all. We cannot see it, and can feel it only when there is a wind or some other force to set it in active motion. Yet the air is a very real substance, or mixture of substances.

We live in an ocean of air and depend upon it for our life, just as fish live in the water and die when taken out of it. Some things, like salt and stones, are **solid**; some, like water and syrup, are **liquid**; and some that move about freely, mixing with the air and often, like it, invisible, are **gases**. You know about the gas that comes into our houses in pipes and is burned for heat and light. This is only one kind of gas. The substances in the air are gases, too.

The Good Fairy Oxygen.—When illuminating gas burns, there is a chemical action going on between two gases; the illuminating gas that came in through the pipe combines with a gas, called **oxygen**, in the air of the room. Wherever *anything* burns, it is this gas, oxygen, which is at work. If a candle flame were covered over with a tight glass jar, the candle would go out as soon as it had used up all the oxygen of the air

inside the jar. For the activities of the living matter in our bodies, we need oxygen, just as the candle flame does. The first object of respiration is to supply oxygen.



Fig. 48.—When men go down into deep parts of mines where there may not be enough oxygen to breathe, they take with them a canary bird, which is very sensitive to poor air, so that its distress may warn them of the danger. If the air is bad, the men can put on the masks hanging in front of them, and breathe oxygen from the bag slung over their shoulders.

It is this gas which passes from the air chambers of the lungs into the blood, as we breathe.

The more you learn about oxygen, the more you

will feel that it is almost like one of the good fairies in the story books. You cannot see it, but it is everywhere about us. Whenever any one strikes a match or lights a fire, Oxygen is at work making the flame burn. The fire of logs around which some band of travelers gathers for warmth in the frozen north, and the great blast furnaces of Pittsburgh where steel is made for mighty ships and for guns, owe their heat and their power to Oxygen. It is Oxygen which makes possible the life of every living thing, from the green slime on the bark of a tree to the tree itself, and from the tiniest insect up to the elephant or man.

Objects of Respiration.—Getting oxygen into the body is only one of the objects of breathing. It is almost equally essential to get rid of certain wastes formed in the body itself. Chemical changes are going on all the time in living matter, and waste substances are being formed, which would injure the body if they were not carried away. One of the most important of these wastes is a gas called **carbon dioxide**, which is carried away from the different organs by the blood and finally gotten rid of through the lungs.

In the walls of the tiny air spaces of the lungs, there is a thin layer of living matter with blood on one side and air on the other. Oxygen passes in from the air to the blood, and carbon dioxide passes out from the blood to the air.

In this way the air in the air chambers of the lungs would, of course, become all the time poorer in oxygen and richer in carbon dioxide, if it were not changed.

Our constant breathing in and out is necessary in order to change the air in the lungs, to bring in fresh oxygen, and carry off carbon dioxide.

Besides carbon dioxide, a good deal of water is given off to the air in the lungs. On a cold day we can see this water condensed as moisture from the breath.

The Old Well.—Two boys were once playing ball on a farm in eastern Connecticut when the ball, which had been thrown a little wild, bounded into an old, unused well and disappeared. The boys peered over the edge and threw a stone in. They could tell by the noise as it struck that there was earth and not water at the bottom.

The walls of the well were made of rough stone; and although it was quite deep, Edward, the elder boy, who was strong and active, thought he could climb down by getting his toes in between the stones and holding on to the old well rope, which was made fast at the top. He had kicked off his shoes when the younger brother, Robert, had a sudden thought. "Wait a minute, Ed," he said, "let us be sure first that the air is all right."

He ran to the house and brought back a candle and some matches and a long piece of string. The boys' father, who was passing, joined them to see what was going on. He helped them cut a groove around the candle, tie a string in the groove, light the candle, and let it slowly down into the well. When it was nearly at the bottom,—all at once the candle went out!

"Well, boys, what does that mean?" asked their father.

"Why, it means that there was not enough oxygen down at the bottom of the well to keep the flame burning," cried Robert in excitement, "and if Ed had gone



Fig. 49.—The boys and their father let a candle down into the well to see if there is oxygen enough to keep the flame burning.

down, there would not have been enough for him to breathe and he might have died."

"Right you are," said his father. "There is plenty of oxygen in all ordinary air, even in crowded rooms; but in old wells and cesspools and the lower parts of mines, where decay is going on, the air sometimes contains a great deal of carbon dioxide and not enough

oxygen to support life. You have studied physiology to good purpose, Bob, I see, and I will give you a new League ball for your good sense and judgment."

How the Breathing Movements are Made.—The machinery by which the breathing movements are made and the air is drawn into the lungs is one of the most interesting things about the human body.

The lungs lie in the chest, in a space bounded on the sides by the ribs and below by a very large muscle called the **diaphragm** (see Fig. 9). The diaphragm is shaped like a big saucer upside down.

Each time we take a breath, two things happen. In the first place, the muscles of the ribs contract so as to pull the ribs upward and outward, which makes the chest space larger from front to back and from side to side. This is the movement we see as we watch the chest rise when a person breathes deeply. At the same time, the diaphragm contracts so as to pull its center downward (flattening out the inverted saucer); this makes the chest space larger from top to bottom. The walls of the lungs are elastic, and anything that makes the chest space larger will make the lungs grow larger, too. As they grow larger, they draw air in through the windpipe from the throat.

These two sets of muscles contract and relax each time we breathe. What is more wonderful still, they change so as to regulate rate and depth of breathing to meet all the changing conditions of our life. When you run, for instance, the muscles that are working hard need more oxygen and make more carbon dioxide

that must be got rid of. So without any planning on your part, the muscles of breathing do more work, and the breaths come more quickly, and the lungs are filled more completely.

The Hygiene of the Breathing Organs.—A full use of the organs of respiration is essential for the health of the body. Anything which hinders the chest movements or cramps the lungs is likely to prevent the full, deep breathing which we need in order to keep well. Wearing tight clothes and sitting or standing in a slouching position have, therefore, a bad effect on the breathing organs.

It is an excellent plan to take a few exercises in deep breathing every morning. Hold your head up and your body straight. Then raise your arms slowly at your sides as you breathe in, and let them slowly fall as you breathe out.

You should always breathe through the nose and not through the mouth. In passing through the nose, the air becomes warmed, and dirt particles in it are taken out, because they stick to the moist surfaces of the nose. Breathing cold air and dust-laden air directly into the throat through the mouth is a dangerous habit. If you cannot breathe comfortably through your nose, there is something wrong, and you should go to a doctor for examination. The doctor will know how to remedy the difficulty, and you will be able to work and play and study better when you breathe properly through the nose.

The walls of the breathing organs are very soft and

delicate, and microbes often grow upon them, as they do in cavities of the teeth, and cause disease. When this happens in the nose or the upper part of the throat, we may call it a **cold** in the head or a **sore throat**. If it occurs in the branches of the windpipe (the bronchi), it is **bronchitis**; if in the lungs themselves, **pneumonia**.

In the back of the throat are two roundish organs called the **tonsils**, which you can see on each side as you look into the mouth. These organs are particularly liable to be diseased, the trouble which results being called **tonsilitis**.

We can avoid these diseases by keeping the microbes that cause them out of the mouth and nose, as far as possible, and by keeping the nose and throat and other organs of respiration so healthy that they can resist any germs which do come along. Both these subjects will be discussed in detail in a later chapter.

The Organs of Speech.—At the top of the windpipe, just below the point where it connects with the throat, is a small but very important organ, called the **larynx** (see Fig. 47). The larynx has in it two bands called the **vocal cords**, which make many of the sounds of speech. The cords vibrate in certain ways, like the strings of a violin or a piano. If you place your fingers on your throat under the chin when speaking, you can feel the **larynx** moving. The larynx does not do all of this work, however, for many of the sounds of speech are made with the lips, teeth, and tongue. Say over the letters of the alphabet and see which ones require the use of these various organs.

QUESTIONS FOR DISCUSSION AND REVIEW

1. How does the air get into your lungs when you breathe properly through your nose?
2. Why is it bad to breathe through the mouth?
3. Give two examples of solids. Of liquids. Of gases.
4. Why are the men in Figure 48 carrying a canary bird?
5. What happens in the lungs when we breathe?
6. What is the diaphragm?
7. How is the air drawn into the lungs?
8. Why do you breathe hard after you have been running fast?
9. What are the tonsils? What diseased condition may occur in them?
10. In what different ways are the sounds of speech made?
11. What movements do you make when you say each of the following letters: B, D, K, L, S, V, Y?

CHAPTER XI

THE CIRCULATION OF THE BLOOD

The Blood and the Blood Vessels.—The food for the various organs of the body is taken in through the walls of the intestines, and the oxygen through the walls of the lungs. Somehow the food and the oxygen must be carried about the body to all the different organs; and you have learned in Chapter II that it is the blood which does this work.

If you could trace one of the tiny blood vessels in the lung, you would find that the stream it carries joins with another and flows into a larger vessel; and that joins with others and flows into a still larger one; and so on, until finally the combined stream from both the lungs pours into the heart. The heart is a hollow organ, about the size of the fist, which lies in the chest between the lungs (see Fig. 50). From the heart, the stream flows out again through a big blood vessel that measures nearly an inch across. This blood vessel branches into finer ones, which in turn branch into still finer vessels; and in these the stream flows at last to the most distant parts of the body, to the top of the head and the soles of the feet and the tips of the fingers (Fig. 51).

The blood vessels that carry the blood into the heart are called **veins**. Those by which the blood flows out from the heart are called **arteries**.

You know how fortunate a city is that is situated on the shore of a river, so that steamers can bring to it food and clothing, wood and coal, and the other things its people need. The blood serves the organs of the body as the river serves such a city, for through every organ the blood is constantly flowing as a stream of life, laden with the food and oxygen the body needs.

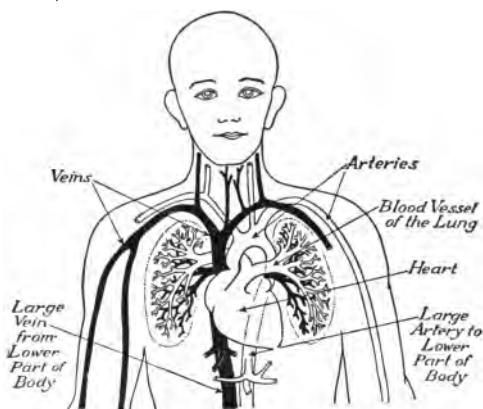


Fig. 50.—The heart and some of the principal blood vessels.

The blood serves another very important purpose, too, for it not only brings to the organs the oxygen and food, but it carries away the wastes which the organs are forming all the time and which they must get rid of, if the body is to keep well.

The Cells of the Blood.—You may wonder perhaps if there is anything in the blood stream corresponding to the ships which sail on a river and carry goods to the city on its banks. There are; and by using a microscope such as was described on

page 102, we can see the ships that sail in the blood stream.

We cannot very well see the blood actually flowing through our own blood vessels even with a microscope; but it is possible to see the blood flowing in the vessels of certain animals which have a very thin, transparent skin. The foot of a frog, for example, has a very delicate skin between the toes; and if the frog's foot is held under

a microscope, one can see a wonderful sight. The thin part of the foot between the toes is full of small blood vessels; and each of these, under the microscope, is

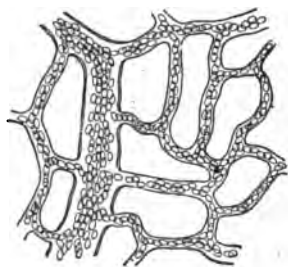


Fig. 52.—The oxygen-carrying cells of the blood, as they appear under the microscope in the tiny blood vessels of the foot of a frog.

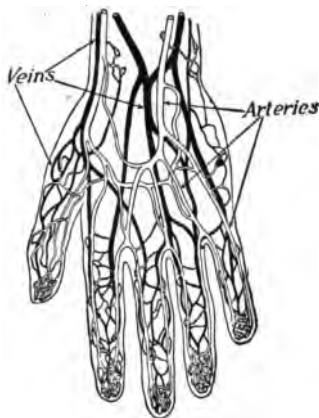


Fig. 51.—The blood vessels of the hand.

seen to be crowded with little round discs, like those which are drawn in Fig. 52. They are not still and quiet, however, as you see them in the picture, but are rushing past at a great speed and tumbling about in the stream, as they are carried along by the blood flow. These tiny ships are the **red cells** of the blood. It is the red cells which carry oxygen from the lungs to the

other organs, and in the tissues exchange the oxygen for carbon dioxide. They carry the carbon dioxide to the lungs, where they give it up and take on a new cargo of oxygen in its place.

These red cells are so abundant in the blood that they give it the red color. The liquid in which they float is not red at all, but a yellowish straw-color.

There is another kind of cell in the blood stream which might be likened to a warship, since we have compared the red cells to merchant ships. These are larger and less numerous than the red cells. As they are whitish in color, they are called the **white cells**. They attack and destroy harmful things, like disease germs, which enter the blood. When we "get over" an attack of influenza or typhoid fever or a cold in the head or some other disease, it is largely because of the activity of these white cells in defending the body against its enemies.

The Work of the Heart.—It takes a great deal of force to drive the blood through these fine channels all over the body, and this force is furnished by the beat of the heart.

The heart is a hollow chamber with very heavy muscular walls. It is all the time expanding and contracting with a regular beat, which one can hear by putting the ear to the left side of a person's chest. At each expansion blood is drawn in from the veins, and at each contraction it is forced out into the arteries.

The waves of pressure set up by the beating of the heart are carried all the way along the arteries. When

the doctor puts his finger on the large artery in your wrist to feel your **pulse**, what he is really doing is to count the beats of the heart as they are recorded by these waves of pressure in the artery.

Richard the Lion-heart.—The heart is a wonderful organ, beating all the time about once every second, and driving the life blood out to all parts of the body. It is such an important part of the body that we often speak of a man who is very good and noble as being “great-hearted,” and of one who is very gentle as “kind-hearted.”

There was once a king of England, Richard the First, who was so brave and such a great soldier that he was called “Cœur-de-Lion,” which is the French for “the Lion-heart.” He won this name because he was so brave that it was thought that he must have a heart something like that of the bravest and fiercest of beasts, the lion. You will read all about him some day, how he led his army into the Holy Land to try to reconquer Jerusalem from the Turks, how he performed many acts of personal bravery, and how on his return he was taken prisoner by an Austrian ruler.

For a long time no one knew where Richard was imprisoned; but according to one story, he was at last found by a faithful minstrel, named Blondel, who had been with him in the Holy Land. Blondel disguised himself and wandered all through Germany and Austria, singing one of the king’s favorite songs under the walls of every castle. He hoped that when he got to the place where Richard was, the king would hear him

and know that a friend was near. At last Blondel's patience was rewarded, for as he was singing at the foot of a tower, Richard's voice took up the next verse of the song in reply. Blondel carried home to England the news of where the king was, and through him Richard was restored to his throne and his country. Blondel must have been somewhat of a Lion-heart himself, if that kind of heart always goes with courage.

Harvey's Discovery of the Circulation of the Blood.
—A long, long time after Richard Cœur-de-Lion reigned, there was another king of England, Charles the First, who had a court physician named William Harvey. It is to Harvey that we owe the discovery of how the blood circulates, for even the wisest people before Harvey's time did not know as much as you know about it—if you have studied this chapter carefully.

Scientific men three hundred years ago knew that blood flowed out through the arteries and in through the veins to the heart. But many of them thought that the blood which went out of the heart never came back, and that the blood which came in was being made fresh all the time from the water and food in the alimentary canal. Harvey was a man who thought things out for himself. As an illustration of his studious habits, it is said that one day when he was placed in charge of the king's children during a battle in which his royal master was engaged, he sat with them under a hedge calmly reading a book all the time the battle was raging. He did more than think and read, however.

He studied nature at first hand, and particularly the actual structure and behavior of the human body. He found out that the same blood forced out by the beat of the heart through the arteries comes back again to the heart through the veins, and is thus kept in a true and constant **circulation**.

How the Blood Supply to Different Organs is Regulated.—The various organs of the body need different amounts of blood at different times. When you are running or playing actively, for example, your muscles are working hard, and they need more oxygen than when they are at rest; they also make more carbon dioxide that must be carried away. In order to meet this need, the heart beats faster, so that the blood with its freight of oxygen will go faster through the muscles. This more rapid beat after active exercise can easily be measured by noting the increase in the rate of the pulse beat at the wrist.

It is not only the rate of the heart beat that varies. The blood vessels also adapt themselves to changing needs. The walls of the arteries are not stiff and hard but elastic, and in these walls there are tiny muscles which make the vessels smaller when they contract and larger when they expand. When a muscle or any other organ is active, the walls of the arteries in that particular part grow larger, so that more blood can flow through it. Think how wonderful is this arrangement by which the needs of all parts of the body are met without a thought or a care on your part.

The Body Temperature.—Another very important

thing which the blood vessels do for us is to help to regulate the body temperature.

When you have been outdoors in winter, your hands and your cheeks often feel cold; but if a thermometer such as the doctor uses were placed in your mouth, it would register between 98° and 99° in January, just as it would in August. This is a very remarkable thing—that the body should keep its temperature just the same, whether the air around it is below zero or nearly 100° . We can make machines, like the incubators used in raising chickens, which will do this; but they do not work nearly so perfectly as the human body does.

Have you ever wondered where the body gets its heat, in the first place? You know, when you get into bed in winter, how cold the sheets are, and how nice and warm they get, after you have been under the covers a little while. All this heat has been formed in your body. As you have learned in Chapter VII, the heat of the body is made from the food. A great deal of this production of heat goes on in the muscles, and when the muscles are actively exercised, you are likely to get overheated.

How the Body Temperature is Regulated.—In order that the temperature of the body shall remain about the same all the time, the amount of heat given off from the body through the skin must just equal that which is formed inside the body. In cold weather, you might expect that the body would lose heat very rapidly and that the blood flowing through the skin would become chilled. The muscles in the blood vessels

of the skin, however, take care that this shall not happen. They contract and make these vessels so small that very little blood can pass through them, and so the heat of most of the blood is kept shut up in the inner parts of the body.

When one is in a very warm room, on the other hand, the body has hard work to get rid of its heat. Then all the blood vessels of the skin expand, so that as much blood as possible is allowed to flow through and be cooled by the outside air. The cheeks become flushed in a hot room, and the whole body becomes pink in a hot bath, because of this enlargement of the blood vessels of the skin.

There is another change that takes place when the air is warm, which helps a great deal in regulating the temperature of the body. All through the skin there are tiny organs called **sweat-glands**. They pour out sweat, or perspiration, as soon as there is danger that the body may become overheated. The moisture thus produced evaporates and cools the skin. You can see that the evaporation of moisture cools the skin, if you wet your finger and then hold it up in a breeze.

In sickness these arrangements are upset, and the temperature of the body often changes. If it goes very much above 99° , we say the person has a **fever**. If one feels half-sick or out-of-sorts, it is a very good thing to have the temperature taken, by putting a special kind of thermometer in the mouth, to see if one has fever. Often the rise in temperature is the first sign that an attack of some disease is beginning.

Alcohol and Tobacco and the Circulation.—The organs of circulation, the heart and the blood vessels, are among the most important of all the organs of the body, and anything which harms them will seriously injure the health of the body as a whole. Both the heart and the blood vessels are especially sensitive to the effect of any poisons taken into the body, for such poisons get into the blood and come into direct contact with their delicate walls. In old people, the walls of the arteries become hard and brittle and do not do their work well. The use of alcoholic drinks is likely to increase this hardening of the arteries, making people old before their time.

Smoking, particularly in young people, affects the heart and makes its action irregular. Boys and men who are training for athletic teams are never allowed to use either alcohol or tobacco.

QUESTIONS FOR DISCUSSION AND REVIEW

1. What is the work which the blood does for the body?
2. What is the difference between an artery and a vein?
3. What would happen if the heart stopped beating?
4. In what ways may the cells in the blood be compared to the ships on a river?
5. What is the work of the white cells in the blood?
6. When the doctor feels your pulse, what can he tell about the action of your heart?
7. Who was Richard Cœur-de-Lion? What does the name "Cœur-de-Lion" mean?
8. What did Harvey discover?
9. Why does the heart beat faster after you have been exercising hard?

10. Why is the body warm?
11. Why do you feel warmer just after exercising briskly?
12. What changes take place in the blood vessels of the skin when you go from a warm room into cold outdoor air? Why is this necessary?
13. Why is it a good plan to have your temperature taken when you feel out-of-sorts?

CHAPTER XII

KEEPING THE SKIN HEALTHY

What the Skin Does for You.—Of what use is the soft pink skin which covers the body? First of all, the skin is like a delicate suit of armor, which fits the body very closely and protects it against germs and other outside dangers. If you break the skin, microbes may easily get in and cause serious disease; and if it were not for the skin, the muscles and other soft, moist organs inside would dry up and perish.

There are a number of other things which the skin does for us, as you have learned in earlier chapters.

It is through the tiny sense organs and nerves of the skin that we learn, by touching and feeling, a great deal about the things we handle, whether they are hard or soft, hot or cold, rough or smooth. It is by means of the blood vessels in the skin that the heat formed in the body is given off; and by the changes in the amount of blood passing through these vessels (as described in the last chapter), the amount of this heat loss is controlled and the temperature of the body as a whole is kept between 98° and 99° . The skin, too, plays an important part in getting rid of the wastes of the body by means of the sweat-glands, which pour out these wastes in the form of perspiration.

All together, you see that the skin is a very important

part of the body. Everything possible ought to be done to keep it healthy, so that it will do its work well.

Keeping Clean.—The skin of the hands and face collects dirt of all sorts, and it takes a great deal of attention, as you know, to keep it fresh and clean. The other parts of the skin that are covered by the clothes need almost as much care, because the perspiration, if not removed by thorough washing, gives the body and clothes an unpleasant odor. The whole body ought to be bathed once a day whenever possible, though in cold weather it will do in the morning to splash the water over face, neck, chest,



Fig. 53.—Two boys' heads: which do you think is the pleasanter to look at?

arms, and the upper part of the body, and then rub the skin thoroughly with a rough towel. A real bath with warm water and soap should always be taken, however, once or twice a week.

The finger nails and the hair grow out from the skin and are really parts of it. They require very special care to keep them tidy. It is unpleasant to see a child's finger nails with a deep black border, or his head looking as if he had just slept in a hay loft. Mr. Nailbrush and Mr. Hairbrush could really have found a good deal to say for themselves in the argument which was quoted in Chapter IX.

It is necessary to keep the hair well brushed, not only for appearance's sake, but to keep the skin of the scalp healthy; and the hair should be thoroughly washed with warm water and soap at least once a month.

Warm and Cold Bathing.—Warm water is, of course, the best for cleansing, but cold water is good for the skin in another way. It is bracing and stimulating, and it helps to train the blood vessels of the skin to do their work well. A person who takes a cold bath every morning is much less likely to catch colds than one who has not stimulated his blood vessels in this way.

Some children who are not strong cannot stand cold baths. If a cold bath leaves a person tired and the skin pale, it is likely to be dangerous. A cold bath followed by brisk rubbing with a rough towel is good for most people, however; and many a child who shrinks from cold water as if it were poison, can train himself so that he enjoys it in a little while. One of the great secrets of keeping the skin healthy is to accustom it to cold so that it can bear cold readily—provided one does not get so cold as to cause a harmful chill.

How Clothing Helps and Harms the Skin.—In severe climates, like that of the northern part of the United States, we have to take a good deal of trouble to protect ourselves from extreme temperatures. When we go out into the winter air, we dress up warmly in clothing made of wool cut from the backs of sheep out on the western ranges, or perhaps in a leather jacket made of the skin of an animal, or a coat made of skin and fur. All this is necessary because in very cold weather

the body could not keep up its temperature of 98° – 99° , and would become chilled so that illness and perhaps even death might result, if it were not protected by warm clothing.

The body loses heat very rapidly when it is damp. It is, therefore, dangerous to have the shoes or the



Fig. 54.—What is wrong about this picture?

clothing wet. After playing in the snow or being out in the rain, one should change to dry things at once on coming into the house.

It is almost as bad, perhaps quite as bad, for the clothing to be too heavy as not heavy enough. Many people make themselves weak and sickly and unable to resist even moderate cold by wearing too heavy clothing.

One of the most dangerous things one can do is to

get heated by sitting indoors or by playing hard outdoors and then to sit down in a cold place with no extra wraps. Clothes should be light for indoors or for violent exercise, and coats or wraps should be put on for outdoors or for sitting still.

Fresh Air.—Just as some people harm themselves by wearing heavier clothing than is really needed, so a great many people injure their health by keeping the rooms in which they live too warm. The still hot air of a close living room or schoolroom or office makes people dull and sleepy. They do not feel like working or playing. Their blood vessels get weak and flabby, so that when they go where it is cold, as they sometimes must, they feel the chill and very easily catch colds and other diseases.

The air of a close room smells stuffy, which is not very pleasant; but the really serious thing is that it is usually overheated. The temperature of the schoolroom or the living room should never get above 68°. In the schools of certain cities, a large thermometer is set up on the front of the teacher's desk in each classroom, with a big red mark opposite 68°, so that the teacher can see when the room is getting too hot. It is a good thing to have the thermometer in this conspicuous place, and it would be still better if some one could invent a thermometer that would ring a bell at 68° and discharge some bad smell into the air when it got above 70°. Then the windows would have to be opened.

Fresh air—that is, cool moving air—is essential to

the health of the skin and the skin blood vessels and to the comfort and health of the whole body.

Ventilation.—We shut ourselves up in heated buildings in winter in order to keep warm; and if we are not careful, we get too warm, and our health may be seriously injured, both by the heat itself and by the sudden shock we feel when we go out into the chill outer air. The remedy for this is to introduce all the time a supply of moderately cool fresh air; this process is called **ventilation**.

In a living room where there are not many people, plenty of air will get in—if it is cold outside—through cracks in the window frames and floors and other places. But where a great many people are crowded together, as in a schoolroom, it is generally necessary to provide some special way for the air to enter. Every human body produces about as much heat as a candle flame, and you can see that if the schoolroom were closed up tightly and a candle were burning in each seat, the room would heat up quickly.

In letting the air in through the windows, we must be careful to avoid a direct draft of very cold air on the people who are sitting near them. Cool air is good and moving air is good, but just as in the case of bathing and clothing, we must be careful not to overdo it. There are several things that can be done to prevent dangerous drafts of this kind. If the steam radiators in a schoolroom, for example, are placed along the wall under the windows, they will warm the incoming air. If sloping glass plates, called window-boards, are

placed inside the window at the bottom, they will shoot the cool air up and mix it with the rest of the air in the room, so that it will not strike directly against any one.

In ventilating with windows, always remember that the air should have a place to come in and a place to go out. Warm air is lighter than cold air and tends to rise. So if a window is open a little at the top and a

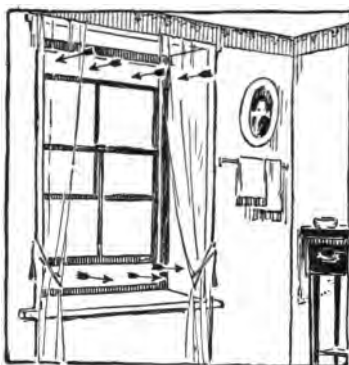


Fig. 55.—A good way to arrange the window so as to ensure good ventilation.

little at the bottom, or if one window is open at the top and another at the bottom, the cool fresh air will come in by the lower opening and the warm stale air will pass out by the upper one.

In many schoolrooms and factories and in most lecture halls and theaters, where a very great many people are crowded together, it is necessary to

provide more fresh air than we can get by opening windows. In such cases, the outside air is drawn in at the basement by great revolving fans, is warmed a little, and is then forced up to the rooms through big pipes built into the building.

Outdoor Life.—No kind of ventilation can make the air in our houses and schools quite as good as the air outdoors, where the sun shines and the wind blows. Every child who wants to get the most out of life while

he is a child, and to be strong and well when he grows up, should play in the open air as much as possible, except when it is very cold indeed or when it is rainy. There is plenty of time for reading and sewing and other indoor occupations in wet weather and in the late afternoon; but swimming, roller-skating, bicycling, baseball, and other games in summer, and skating, coasting, and playing in the snow in winter are better than books, while the sun is shining.

In the sleeping room, the windows should always be open, wide open in summer and open a few inches even in the coldest weather, for you cannot really get the most rest out of your sleep time unless there is cool air moving about you. Many people find it pleasant and healthful to sleep out of doors on a sleeping porch or balcony and, where this is possible, it is a very good plan to follow.

Nancy's Dream.—Once upon a time a little girl named Nancy dreamed that she and her friend, Virginia, were walking together through a wood in winter. Soon they came to a high rocky cliff that rose up among the trees, and in the middle of the cliff was a cave. A red light shone out of the mouth of the cave; and as they drew nearer, holding each other's hands because they were just a tiny bit frightened, they saw that a big fire was burning inside. About the fire, little figures were moving. When two or three of them came out to see who was passing, the children were not frightened any longer, for they saw that the people who lived in the cave were little Mountain Elves. The Elves came

up to Nancy and Virginia and bowed very politely, almost touching the ground with their tall, pointed caps.

"Won't you come in, pretty children," they said, "and rest by our fire? You can lie on soft couches of pine needles in the warm cave, and we will sing you to sleep with our sweet mountain lullabies."

"That sounds pleasant," said Nancy, "and it is very polite of you to ask us."

"Wait a moment, though," said Virginia. "Who are these coming?"

They all looked around, and who should come trooping through the wood but a whole party of Snow Fairies, dancing and leaping and frolicking, with little shiny crowns of snow crystals in their hair.

"Come and play with us, children," they cried, "Come out and romp in the snow. We will chase you and roll you over and pinch your cheeks with the frost, till they shine as pink as round apples in the autumn. Our hearts are as light as the snow that the wind drives before it, and we sparkle like the snow crust when the sun shines on it through the forest."

"I want to play with the Snow Fairies," cried Virginia joyously.

"No," said Nancy, "it is cold and I shall stay in the cave." This was a dream, remember. In real life Nancy and Virginia were such good friends that nothing would have separated them; but in the dream Virginia went off to play with the Snow Fairies and Nancy dozed in the cave of the Mountain Elves.

Late in the afternoon Virginia and the Fairies came

storming back, and the light of the sun was in their eyes and the breath of the wind was in their dancing. And Virginia cried, "Oh, Nancy, we have had the most wonderful time. We have played tag among the trees on the smooth snow crust, and we have coasted down the hills and built snow houses in the hollows. I never had such a beautiful day in my life. What have you done, Nancy?"

But Nancy, having done nothing at all but doze over the fire, felt dull and cross and sleepy. So when she woke up after the dream was all over, she made up her mind she would go out and play with the Snow Fairies instead of staying by the fire, when she had the chance next time.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Name four different things that your skin does for you.
2. Cold baths are generally taken in the morning and warm baths at night. See if you can think of any reason for this.
3. The parts of the body that are covered by the clothes do not come in contact with dirt outside. Why do they need washing?
4. Describe the heads of the two boys shown in Fig. 53. Tell what you think their clothes and hands probably look like, and what their habits probably are.
5. Why are cold baths good for the skin? How can you tell whether your bath is too cold?
6. Why should wet clothes be changed as soon as possible?
7. What should be the highest temperature of the schoolroom? What happens if the schoolroom gets too hot?
8. What is ventilation?
9. How should your sleeping room be ventilated?

10. Find out how your schoolroom is ventilated. If there is a special system of ventilation in the building, find out the location of the registers for letting the air in and out.

11. Eleanor took a cold bath and a brisk rubdown every morning. She played outdoors as much as she could. She wore wraps when it was cold, and took them off at once when she came into the house. Susan hated cold water, and wore heavy clothing all the time, and sat huddled up over the fire reading in a close room most of the afternoon. When an epidemic of grip broke out in the school, which one do you think caught it? Explain why.

12. Tell the story of the Snow Fairies and the Mountain Elves in your own words. What lesson did Nancy learn from her dream?

CHAPTER XIII

FREEDOM FROM BAD HABITS

The Story of William Tell.—Freedom is one of the things for which we Americans care more than for life itself. Again and again the Stars and Stripes have gone into battle for freedom, from the time our nation was born in 1776 until we entered the greatest of all wars for liberty in 1917. So we like to hear stories of other peoples who have fought for freedom against heavy odds; and one of the best stories of this kind is about William Tell.

About six hundred years ago, according to this story, the Austrian emperor had sent his soldiers into certain parts of Switzerland to rule over the land. His governor in one part of the country, according to this story, was a man named Gessler, who oppressed the unhappy Swiss people with every kind of cruelty. Among other wicked and foolish acts, he set up in a certain town a tall pole with an Austrian cap on the top of it, and he ordered that every one who passed should uncover his head before the Austrian cap, as a sign of reverence for the emperor.

There was a party of brave Swiss who were not willing to submit to the tyrants, and among them was a famous bowman named William Tell. (There were no guns like ours, in those days. Men fought with crossbows,

which shot arrows instead of bullets.) Tell and his little son walked past the pole one day and did not take off their caps to pay respect to Austria. They were quickly arrested by the soldiers; and Gessler thought of a cruel punishment, which he hoped would frighten the people and make them submit. He balanced an apple on the boy's head and said to the father: "I hear you are a great shot with the crossbow. Let me see you cut that apple in half with an arrow. If you miss it, I will have you put to death."

Gessler thought that both the boy and his father would be frightened, and that Tell would either kill his own son or miss entirely. But the boy stood up as firm as a rock and smiled bravely at his father; and William Tell himself aimed coolly and hit the apple right in the middle, so that it fell in two pieces, without a hair of his son's head being injured. A great shout of joy went up from the people. As the gallant archer turned away, a second arrow fell from his belt.

"What was that second arrow for?" asked the governor.

"To have shot you, if the first had slain my son," replied William Tell.

For this bold reply he was arrested again; but he escaped and later he killed Gessler with one of his swift arrows. According to the story, this was the beginning of the long war in which the Austrians were finally driven from Swiss soil, so that Switzerland became free, as she is to this day.

Some Enemies to Freedom.—Freedom, of course,

does not mean that each of us is free to do just as he likes without consideration for the good of other people. A man who is free is one who can do what he believes is right, so long as it does not harm any one else. The



Fig. 56.—William Tell was able to hit the apple on his son's head and defy the tyrant because both he and the boy had strong muscles and steady nerves.

things that Gessler wanted William Tell to do were foolish and wicked. We are all glad the Swiss fought successfully against the Austrians; and we Americans will always be ready to fight against any one who tries by force to make weaker peoples do what is wrong.

There are other things, however, that rob people of their freedom, besides kings and emperors. There are

men and women in the United States to-day, men and women in your own state and town, who are not free. Do you know what it is that makes them slaves, that keeps them from doing what they know is really good and right?

You have learned in an earlier chapter something about habits—how easy it is to form them, and how hard it often is to break them after they are formed, whether they be good habits or bad. It is *bad habits* that rule over these people we have been thinking of, as Gessler tried to rule over the Swiss,—the habit of eating or drinking or smoking some particular thing that is bad for them, that they know is bad for them but have not the strength of character to give up. When a man says, "I cannot get along without my coffee," or "I must have a cigar, for I cannot work without it," or "I am no good without my glass of wine or of whiskey,"—he is not a free man but a slave to a bad habit. It is part of the duty of a good American to keep himself free from such habits, as well as free from tyrants of the human kind.

Tea and Coffee.—The fact that tea and coffee sometimes become tyrants does not mean that such drinks are necessarily bad. For grown people, particularly when they have been working hard, a cup of tea or coffee is often a good thing. Tea and coffee are what are called **stimulants**, that is, they make a person who is tired feel fresher and more vigorous for a time.

The use of stimulants, however, is something like urging on a tired horse. Sometimes when there is just a

little way farther to go, we may have to do it; but if a tired horse is driven too far, he will break down. If a tired body is forced to work too hard, it is likely to break down, too. Above all, it is very dangerous to depend on stimulants so that we grow to need them all the time, and cannot work or enjoy life without them. Then one has become a slave, which a real American will never be.

A child has no necessity for stimulants at all. Older people may sometimes be so tired that they need them, but no healthy child ever does. A child is much more sensitive to the harmful effects of tea and coffee than a grown person; and the use of these drinks may do children serious harm.

The Tobacco Habit.—Another of the habits for which people sometimes give up a good share of their freedom is smoking.

The use of tobacco is more objectionable than the use of tea and coffee. Smoking is an expensive habit, for a good deal of money is burnt up in the course of a year in the form of cigars or cigarettes. It is an unpleasant habit for those who do not share it, since it fills the air and the clothes and the hair of every one in the room with stale-smelling smoke. It is a habit which may do serious damage to the health. People who smoke a great deal injure the soft, delicate surfaces of the nose and throat and are likely to have a nasty, dry cough as a result. They injure their digestions and their hearts; a heavy smoker cannot exercise actively without panting and puffing, because his heart is usually

not strong enough to supply the needs of his muscles fully. They injure their nerves and their brains. The hand of a hard smoker often trembles as a result of this action upon the nerves. Boys and men who are



Fig. 57.—Men and boys who are members of athletic teams are never allowed to use alcohol or tobacco.

training for rowing and football and other athletic contests are never allowed to smoke.

As in the case of tea and coffee—only much more so—the danger from tobacco is most serious in youth. Grown people can smoke a little without harm, provided they do not form so strong a habit that they are no

longer free to stop when they wish. For children and young people, tobacco is always harmful. No boy who wants to be strong and well, a successful man and a good citizen, will touch it in any form.

Medicines and When to Use Them.—When you are ill, the doctor is sent for, and sometimes perhaps he gives you medicines. These medicines, or the substances they contain, called **drugs**, are given for particular effects they have on the body, to remedy something that is going wrong. For instance, if a person is very ill and his heart is weak, a stimulant drug may be given to make the heart beat more strongly. Only the doctor can know when drugs should be given, what ones to use and how much of each; and even doctors nowadays do not use drugs nearly as much as they used to.

Yet some people who ought to know better take medicines without asking the doctor at all, medicines perhaps which are sold at the drug store with labels claiming that they will cure all sorts of diseases. Such medicines are almost always useless. Many of them are absolute frauds, put up simply to cheat people out of their money; and others contain dangerous drugs which may do very serious harm.

The most dangerous of all medicines are certain drugs which affect the brain and nerves, and which people get in the habit of taking and soon cannot get along without. The most unfortunate people on earth are those who have lost their freedom by becoming slaves to certain of these drugs.

The only safe rule is never to use medicines or drugs of any kind, except under the doctor's orders.

Alcohol as a Drug.—There is one harmful drug which many people have unfortunately used more or less regularly in their daily life. This drug is **alcohol**, which is present in wines of various kinds and ale and beer, and in much larger amount in "strong drinks," such as rum, gin, brandy, and whiskey.

Alcohol is not a stimulant, like tea or coffee. It does not wake a person up, but rather puts him partly to sleep. At first it affects only certain parts of the brain and particularly the inhibitions which you learned about in Chapter V. What do you think will be the result if something happens to make the inhibitions work less effectively? A person who has taken a drug of this kind would be likely to do things and say things that he would have too much sense and judgment to do or say if he were not under its influence, would he not? That is just the effect of alcoholic drinks if they are used in excess; and a very little may be an excess for many people. So the alcoholic drinks are excellent examples of things that take away the freedom which is the privilege of every American citizen, the freedom to do always what one really believes to be right and proper to do. No one who is under the influence of alcohol is a free man.

The Effect of Alcoholic Drinks on Health.—When alcoholic drinks are used in excess, they do direct damage to many different organs of the body. They may injure the delicate walls of the stomach. They damage

the liver and the kidneys. They cause disease in the heart and the walls of the blood vessels. These effects are so serious that people who drink a large amount of alcoholic liquor—and also those who drink only moderate amounts but do it as a regular thing year after year—do not live so long, on the average, as those who are free from this habit.

Alcoholic Drinks and Success in Life.—Long before alcohol shows its effect upon the health of the liver and blood vessels and the other organs mentioned, it begins to influence the nerves and brain, and through them lessens the power to do any sort of hard and skilful work. Even a single drink of the stronger alcoholic liquors affects the quickness of a man's nerves and the accuracy of his actions. He becomes a little bit slow and a little bit clumsy.

The world nowadays has not much use for slow and clumsy people. In the factory and in the office, a man or a woman must think quickly and act quickly; and the one who will get to the top is the one who can do the work best and in the shortest time. So most of the large employers of labor long ago decided not to employ men who drank alcoholic liquor. Many railroads, for instance, forbade their men to use alcohol at all. Think what might happen on a railroad if the engineer's brain were not perfectly clear and his hand perfectly steady. The lives of the people on the train may depend on his seeing a signal and stopping at the right moment; and those lives will be in danger if he has clouded his brain by drinking alcoholic liquor.

It is not only personal success that a man gives up if he becomes a slave to the habit of using alcohol. The



Fig. 58.—The safety of hundreds of people depends on the sureness and the quickness of the man who drives the locomotive. If he should weaken his power of control by the use of alcoholic liquor, all their lives would be in danger.

railroad engineer who wrecks his train because he was not sober is himself one of hundreds who may perhaps be killed as a result. Whenever we do any of our work badly, it hurts some one else.

The Cost of Alcohol.—The habit of using alcoholic drinks is a very expensive and a very wasteful habit. It wastes health, on account of the direct damage done to the drinkers. It wastes time and energy, on account of the poorer work they do. It wastes the money which it costs to build and keep up the factories where the alcoholic drinks are made. It wastes the valuable food substances which are used to make them.

Wines are made from grapes, by pressing out the juice and letting it stand and ferment. Fermentation is a change of the sugar in the grapes into alcohol and other substances, and this change is brought about by the action of microscopic plants called yeasts (like the yeast in a yeast cake). Most alcoholic liquors, except wines, are made in a similar way from grains of various kinds. You know that when the Great War began there was not enough grain in the world to feed all the people who needed it; so that in Belgium and France and Russia there were many people who were very hungry. It was clearly a poor plan to take the grain that men and women and children needed to keep them alive, and turn it into alcoholic drinks which could only do harm.

Alcohol in War Time and After.—When a nation goes to war, every one must work harder and better than ever before for the common good. The men in the army, the men and the women in the factories and on the farms and in the shipyards, the women who are saving food at home and working for the Red Cross,—yes, and the children, too, in the Junior Red Cross,—every one must do his or her very best. There is no

room any more for people who are made slow and stupid by the use of alcohol.

So, very early in the Great War which began in 1914, Russia stopped the sale of strong alcoholic drinks. Then France and England passed laws to limit the use of strong drinks. They knew that no nation can do anything with all its might if its people are dulled by alcohol. America came into the war, and the same thing happened here. President Wilson stopped the making of strong alcoholic drinks during the war, and the Congress at Washington passed an amendment to the Constitution of the United States which forbade the sale of all kinds of alcoholic liquors and which, having been agreed to by more than three-quarters of the states, became a part of the Constitution.

These lessons learned in war time as to the harmful effects of alcohol will not be forgotten. As a result of the war, it seems likely that millions of people will be freed from the habit of using alcoholic liquors, a habit which has perhaps done more harm in the world than even tyrannical emperors and kings.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Tell the story of William Tell and the tyrant, Gessler. What lessons does it teach?
2. What sort of things, besides tyrannical kings, may rob people of their freedom?
3. What is a stimulant? What happens if stimulants are used too much?
4. What are some of the objections to the use of tobacco?
5. Two high school boys were training for an athletic team.

Their captain had warned them not to smoke. One of them did as he was told, but the other had formed the habit of using cigarettes and went on using them in secret. Tell which one was the *freer* of these two boys, the one who did what he was told or the one who did not, and explain why.

6. Why is it foolish to use medicines without asking the doctor?

7. What effects does alcohol have on the activities of the body?

8. Explain why it is dangerous for a man who drives an automobile to use alcoholic drinks.

9. What are wines made from? What are beer and whiskey and most other alcoholic drinks made from? What better use could be made of the materials from which these drinks are manufactured?

10. Why did most of the great nations limit the use of alcoholic drinks in war time? Do the same reasons apply in times of peace?

CHAPTER XIV

OUR UNSEEN ENEMIES

Daniel Boone, the Indian Fighter.—Did you ever think that the place where you now live was once upon a time deep forest or open prairie, with no houses or farms but only wild beasts and a few Indian huts? Perhaps it is a great city now with tall buildings and trolley cars; or it may be a pleasant countryside of rich farms and peaceful villages. A hundred years ago, however,—or two hundred or three hundred,—it was all wild country. The first explorers were in constant danger from the forest creatures and the Indians, and they knew they might have to fight for their lives and the lives of their families at any hour of the day or night. Perhaps you have seen pictures of the Puritans in New England going to church on a Sunday morning, each man with his gun on his shoulder, ready in case an Indian attack should come.

After the Atlantic states had been settled, the white men pushed farther and farther west. In each place the brave pioneers took possession of the new lands at the risk of their own lives. One of the most famous of these pioneers was Daniel Boone. He was born more than a hundred and fifty years ago in Virginia; but he soon sought for adventure in the unknown lands to the west. He and five other companions pushed out into

the wilderness of what is now Kentucky. Boone was taken prisoner by the Indians, but made his escape and lived for nearly two years in the forest, part of the time alone and part of the time with his brother, who had followed him from their home. The Boones were mighty



Fig. 59.—Daniel Boone, pioneer fighter of wild beasts and Indians. The microbes must be fought to-day, as the bears and wolves were fought a hundred and fifty years ago.

hunters and trapped and killed bears and other wild animals, so as to make furs out of the skins.

In 1775 Daniel Boone went out with a large party and built a fort of logs at the place now called Boonesborough. Three times this fort was attacked by the Indians, and the last time there were four hundred and fifty of them against Boone's little force of fifty men.

Can you imagine the wooden fort with narrow loopholes through which the guns of the white men were pointing, as the Indians came dashing out of the forest to the attack? No enemies had any terrors, however, for Boone and his companions. They beat off the Indians, even though they were nine to one against them; and after this the fort at Boonesborough was never attacked again.

We ought always to remember gratefully these brave men who went out into new lands and killed the wild beasts and cut down the forests so that we could have farms and villages and cities and enjoy them in peace.

Our Enemies of To-day.—We do not have to fight wild animals any more. Daniel Boone and other pioneers have driven them away, so that we can live in peace so far as they are concerned. There are still enemies about us, however, in every city and town and country village. You never hear your father say that Mr. Smith or Mr. Jones has been killed by a bear, as Daniel Boone's children must have sometimes heard their father say when he came home from hunting. But you do sometimes hear that Mr. Jones or Mr. Smith has died of typhoid fever or tuberculosis or pneumonia. It is against these diseases that we must fight, as our great-grandfathers or great-great-grandfathers fought against wild beasts in earlier days.

There are some kinds of sickness that we cannot avoid. When a person grows old, he gradually becomes less and less vigorous and at last is sure to suffer from sickness of some kind. In youth and even in childhood

certain people are naturally not so strong as others. There is another class of diseases, however, which are not the result of any necessary weakness of the body but are caused by something which comes from outside, an enemy just as real as the Indians who attacked the fort at Boonesborough; and such diseases can be avoided.

The enemies which cause the diseases we are thinking about are the tiny living things called **microbes** or **germs**, discussed in Chapter IX. They are so small, you remember, that we cannot see them at all, except by using a very powerful microscope. They are smaller even than the cells of the blood that were described on page 123. Yet it is these microbes that cause some of the commonest diseases from which people suffer—from colds to diseases like tuberculosis,—and sometimes they produce great epidemics that kill hundreds of thousands of people, as the influenza did in 1918. Such microbes kill more people in the United States in one year than the Indians ever did in the whole history of the country.

Fighting the Microbes of Disease.—You have probably seen a jar of jelly or preserves that had become spoiled, with patches of mold on the top of it. This mold is a microbe, which grows in masses so large that you can see them; and microbes produce disease very much as the mold microbe spoils the jelly. Each kind of microbe causes its own particular sickness—one, diphtheria; another, measles; another, scarlet fever; another, whooping cough. When a child has diphtheria,

for instance, it is simply because the germ of diphtheria has gotten into his throat and is growing there and poisoning his whole body. If we could keep out the microbes,



Fig. 60.—Louis Pasteur, the great Frenchman who discovered that microbes were the cause of many of our deadliest diseases.

that child would never have diphtheria; and in the case of many such diseases, we have learned how to protect ourselves very effectively from these invisible enemies.

The man who first showed how to conquer the diseases caused by microbes was a great Frenchman

named Louis Pasteur (păs tūr'). Fifty years ago no one knew the cause of typhoid fever or tuberculosis or any of the other diseases of this kind. People fell sick, sometimes one or two at a time, sometimes by hundreds and thousands, and there was little that any one could do to protect them. It was like fighting against Indians that you could not see at all. What chance would there be if invisible enemies could shoot off their arrows at you, and you could never tell where they were and could never see them to strike back?

It was Pasteur who first revealed to us our microbe enemies. By the use of the microscope, he found that in the bodies of animals and men suffering from certain diseases tiny living germs were growing. At first no one would believe that they had anything to do with causing sickness; but Pasteur worked patiently on and showed that in each of these diseases there was a special kind of microbe, and that this particular microbe was, in each case, the cause of the disease.

Microbes as Friends and Foes.—There are many different kinds of microbes, and only a few can produce disease. There are microbes all about us, a few floating in the air, a few in the water we drink and the food we eat, more in the dust on the floor, a great many in the earth in the garden, and a great many in the mouths and alimentary canals of people and of animals. Most of them are entirely harmless, and some, as we shall see, are really good friends of ours.

The Bacteria.—The commonest kind of microbes are called bacteria. They are really very small plants;

and if you were to look at them under the microscope, they would look something like the things you see in Figure 61. You never would think they were living plants, would you? They look like little sticks or balls, and are so small that 400,000,000 of them could be packed into a single grain of granulated sugar. Yet



Fig. 61.—The shapes of some of the commoner kinds of bacteria, as they are seen under the microscope.

they are really alive. Some of them can move about, and under the microscope you can see them swimming along quite merrily.

When bacteria are living in something which they can feed upon, they grow larger and larger, till finally each one splits in half, and you have two microbes where there was only one before.

While they are doing this, they are destroying the substance they are feeding on, and often they change its appearance and its smell and its taste, so as to "spoil" it, as we say. The decay of meat, the souring of milk, the molding of jellies and preserves, are all the result of the action of the bacteria or other microbes which are growing in them. If there were no microbes, food would not spoil at all. When your mother puts up

preserves, she heats the jars and the preserves themselves, so as to kill all the microbes that may be there; and if the preserves do not keep, it is because some of the microbes were not killed or others got in afterward.

Some Helpful Microbes.—Some kinds of microbes are really helpful to us. The taste of butter is the result of the action of bacteria growing in the cream from which the butter was made. The flavor of cheese is produced by other microbes. Vinegar is made from apple juice by the action of microbes. Above all, the microbes which live in the soil are very useful indeed in helping to make the soil rich and fertile so that plants can grow in it.

In far-northern Iceland, people used to believe that there were two sorts of elves or fairies. The White Elves were good fairies, who helped bake the bread and churn the butter, who found things that were lost, and sometimes swept the floor and tidied up a room that had been left in disorder overnight. The Bad Elves, on the other hand, were mischief makers, who hid and broke things about the house, pinched the cat's tail to frighten it when it was asleep, and led people astray at night in the marshes by showing false lights where there were no houses at all. The microbes are really somewhat like these invisible fairies. We cannot see them, but they are all about us. Some of them are our friends, like the ones that make cheese and work in the soil; some are our enemies, like those that spoil foods and those that cause disease.

Where the Disease Microbes Come From.—Most plants and animals have a special sort of place where they live, and we never find them anywhere else. Certain fishes live in the sea. Other kinds of fishes can live only in fresh-water lakes. Certain birds, like the sea-gulls, are found only near the ocean. Certain kinds of insects live under stones or in old decaying logs, while others fly about in the sunny meadows. It is very much the same with the microbes. Some can live in earth, others in water; and the kinds that cause sickness generally live and thrive only in the human (or animal) body.

This is one of the great lessons that we have learned from the work of Pasteur: that the germs of disease do not come from the air or the soil but from the bodies of people. We know now why diseases of the kind that are caused by microbes are “catching.” When we say some one has “caught” cold, we mean that he has been near some one else who had a cold, and that the microbes that cause a cold have been passed from one person to the other. Measles, scarlet fever, whooping cough, diphtheria, typhoid fever, pneumonia, tuberculosis, and many more are diseases that are “catching” or contagious.

The person from whom you “catch” one of these diseases need not necessarily be ill himself. Sometimes if one is strong and well, the germs of a certain disease may get into his throat, for instance, and live there for a while without making him ill. Yet this person can pass on some of these germs to some one else who

is not so strong, and the second person may fall sick as a result. Well people who have the germs of disease growing in their bodies in this way are called **carriers**, because they carry the microbes about with them.

Disease germs can live for a little while on things that have been handled by a sick person or a carrier—in food, for instance, or on handkerchiefs. Soon, however, they will die, unless they get into the body of another human being, where they can begin to grow again. Now you can see how it is possible to prevent these diseases. Since every cold in the head, every case of measles, scarlet fever, or any other sickness of this kind, is caused by the passing on of germs from one person to another, we can stop the disease by preventing the spread of the germs.

How the Disease Microbes Pass from One Person to Another.—There are three principal ways by which the invisible germs are passed from one person to another; and if you understand these three ways, you can do a great deal to keep yourself and other people about you safe from their attacks.

First of all, the microbes may be passed from one person to another by direct contact or touching. Suppose your father has a cold and you kiss him. You will probably get the cold germs on your lips, and very soon you may come down with the cold, in your turn. When he coughs or sneezes, a fine spray of moisture is thrown out from his mouth, and in these drops of water there will be the germs which were growing in his mouth.

If he sneezes behind his hand and then touches your hand, and your hand goes to your mouth or nose, the germs will be passed on to you, in a more roundabout way but still by contact.

A second way in which disease germs often find their way from one person to another is by means of water or milk or some other food. If a man who is suffering from some germ disease coughs over a milk pail, the microbes from his mouth may be mixed up with a whole batch of milk at the dairy and may be carried to hundreds of people as a result.

Finally, the germs of some diseases are carried from one person to another by insects, such as flies and mosquitoes.

We sometimes speak of these three ways of spreading disease as the Three F's—**Fingers, Food, and Flies**—*Fingers* meaning all the various ways by which germs pass from one person to another by contact; *Food*, the spread of the germs by different foods; and *Flies*, the carrying of disease microbes by flies and other insects.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Who was Daniel Boone and what did he do?
2. What enemies are there in your town against which you will have to fight? Are there any men in the community who are leading in this fight, as Boone and his companions led in the fight against wild beasts?
3. Which do you think is more dangerous: a bear or a disease germ? Give your reasons.
4. What causes food to spoil? How can the spoiling of food be prevented?

5. Who was Pasteur and what did he do?
6. What are some of the good things that microbes do for us?
7. What really happens when a person "catches cold"?
8. What are some of the diseases caused by microbes? Which ones have you had?
9. Can you catch a disease from a person who is not sick himself? Explain.
10. In what three general ways do disease germs pass from one person to another?
11. Does a person who is careless about catching diseases harm any one besides himself? Explain.

CHAPTER XV

CLEANLINESS AND HEALTH

The Wooden Horse of Troy.—Once upon a time the armies of the Greeks were at war with a people called the Trojans, who lived in the powerful city of Troy. For a long while the Greeks camped outside the walls of the city and tried to capture it, but the Trojans with spears and arrows and great stones drove them off and killed some of their bravest leaders.

At last Ulysses, one of the wisest of the Greeks, thought of a plan by which to capture the city through a trick. The Greeks pretended to be giving up the attack, and their ships sailed away and hid behind an island near by. The Trojans, thinking the war was over, poured out of the city where they had been shut up and eagerly examined the deserted camp of the Greeks. In this camp they found a very strange thing, an enormous wooden horse.

They were curious about this horse, for no one could think what it might be for. Some wanted to bring it into the city as a prize; others were afraid and advised that it be left on the seashore. At last they were persuaded that it would be a fine thing to have the wooden horse in the city. So they managed with great difficulty to get it inside the walls and ended the day with feasts and rejoicing.

Now this is what the clever Greeks had done. The great horse was *hollow*, and inside it were Greek soldiers. In the night when the Trojans were all asleep, these soldiers came out and opened the gates of the city to the rest of the Greeks, who had sailed back and landed again after nightfall. In this way the mighty city of Troy was at last taken.

What do you suppose this story has to do with keeping well? Just this. The disease germs are our enemies, just as the Greeks were the enemies of the people of Troy. We can keep them out, just as the Trojans could have kept out the Greeks; but very often we do what the Trojans did. We bring the enemy into the city; we put the germs of disease right into our own mouths. Let us see how we can be on our guard against doing anything so foolish.

The Camp of the Enemy.—The Trojans knew that the wooden horse had been made by the Greeks and left by them in the camp, and they ought to have been on the watch for some danger from it. Where should we look for our enemies, the disease microbes, so that we may not let them get into our bodies?

You learned in the last chapter that these disease microbes always come from the bodies of other people. In most cases, it is the discharges from the nose and throat in which our invisible enemies lie hidden. The spray thrown out in coughing and sneezing, the matter coughed up, and the material that soils the handkerchief—these are the original sources of infection. Any one who has a cold or any other sickness should take

the greatest care to avoid spreading these discharges. People should always cough or sneeze in a handkerchief and not in some one else's face. They should not kiss other people or shake hands with them when suffering from any germ disease. They should not leave soiled



Fig. 62.—Faithful guardians of the public health.

handkerchiefs about or handle unnecessarily anything that other people may have to handle afterward.

In some diseases, like typhoid fever, the germs are in the discharges from the bowels and bladder, and this is the reason why every one should take the greatest care to wash the hands thoroughly after using the toilet.

Your Busy Fingers.—The fingers are among the busiest and most useful parts of your body. Writing,

sewing, playing the piano, carrying things, and holding things—there are few waking hours when they are not serving you. In the course of the day they handle many things, and many of these things are dirty. Nearly everything you touch has microbes on it. Most of them, of course, are harmless germs; but often there will be other kinds that have come from some person who was coming down with a disease or who was a carrier of the germs of disease. Then if you are not careful, those busy fingers of yours may play the part of the wooden horse and carry the enemy right to your mouth, or to the piece of bread or the apple that is going into your mouth.

This is the reason why older people are right in saying to you so often, "Wash your hands, Johnny," or "Your hands are dirty, Susan." It is not simply that they are fussy about your looks, though dirty hands are not very pleasant to look at.

Above all, it is important to wash those busy fingers very carefully before handling food that is to go into your mouth. There is no rule more important than the rule that *The hands should be thoroughly washed before you eat*. It does not matter whether your hands look clean or not. There might be millions of germs there, without your being able to see them. The next time that it seems a bother to go and wash your hands before lunch or before eating an apple, remember the Trojan horse. Don't let the microbes play a trick on you. Scrub them away with warm water and soap. Do a good thorough job of it, and then wipe your hands

on a *clean* towel. All the good of the washing may be undone if you use a towel that some one else has used, for then a good supply of his germs may be rubbed on your hands, just at the time when you think they have been cleaned.

The Mouth as the Gateway to the Body.—Since it is generally by way of the mouth that the germs of disease find their way into the body, we ought to guard our mouths just as carefully as the Trojans guarded the gates of their city, before they made their great mistake about the wooden horse.

There is no more disagreeable trick, and no more dangerous trick, than the habit many children have of picking at nose or mouth and putting into the mouth pencils, pins, money, marbles, and all sorts of dirty things. Just think a little what the history of some of these things may have been. The pencil was perhaps used last by another child who had the same bad habit of putting things into his mouth. He may have been coming down with diphtheria, and if so, you will put the germs of diphtheria right into your own mouth if you put the pencil there. Or the penny may have been dropped on the street and may have rolled through a place where the germs of tuberculosis had been discharged by a consumptive who had spit on the sidewalk.

You never know when things like this may happen. It is absolutely impossible not to handle many things that are dirty; but you can keep them from your lips. The only safe rule is: *Let nothing go to your mouth except*



Fig. 63.—Food in a pastry shop exposed to pollution from flies and dust and handling.

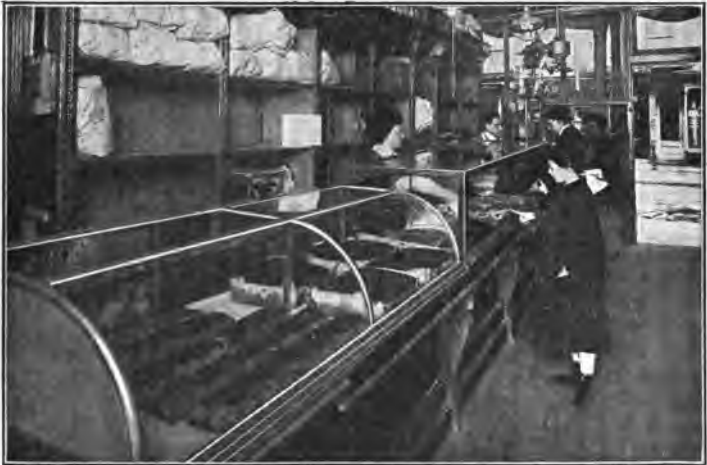


Fig. 64.—The same shop with the food properly protected.

clean food and your toothbrush. Let nothing go to your nose except a clean handkerchief.

Clean Food.—It is very necessary, of course, that the food which is to go into your mouth should itself be



Fig. 65.—The use of a common drinking cup is one of the best ways to pass germs from one mouth to another.

clean and free from harmful microbes. Food that has been handled by a sick person or a carrier may easily pass the disease germs on to some one else. Milk has often spread disease to hundreds of people at a time; and so has water, in cases where it has been polluted by sewers emptying into the stream or pond from which the water was taken.

A person who is feeling ill should never handle food that is to be eaten by other

people; and since one may be a carrier without knowing it, the hands should always be washed before preparing food.

In buying foods, particularly fruits and other foods that are eaten raw, it is a good plan to avoid those that

are exposed in the open street, or in the store, to flies and dust. Think where the fly that walks over a fine bunch of grapes may have been walking last! In many cities the law requires that all such foods must be kept under glass or covered in some other way. The same care should be taken after the foods have been brought home, for a fly in your kitchen may be just as dangerous as a fly in the grocery store.

Spoiled foods are likely to contain germs that make people ill, and so it is important that foods should be kept in a cool place and not kept too long. Chopped or minced food should be watched carefully, for it is particularly apt to decay. If any food is the least bit spoiled, it should be thrown away.

Since the most dangerous kind of dirt is the material from the mouth of another person, a drinking glass or cup that has been used by some one else is always a dirty thing. Even when it looks quite bright and clear, you would find a great many microbes on the rim where it had touched the lips, if you examined a little piece of the rim under the microscope. Don't be a foolish Trojan and put germs that may be dangerous into your mouth, by using a drinking cup that has been used by others. If you have not a glass of your own and there is no bubble fountain in school, you can learn to make a very good drinking cup out of paper by folding it as shown in Fig. 66.

Raw Foods and Cooked Foods.—It was a very clever man (or woman) who first invented cooking. Cooking not only makes the food taste better and makes it easier

to digest, but makes it safer to eat and much less likely to carry the germs of disease. The heat applied in most methods of cooking will destroy any disease germs which might be present. If there is any doubt about the drinking water, it can be made quite safe by boiling it.

Raw milk has probably caused more cases of disease than any other food (except water), for it may carry

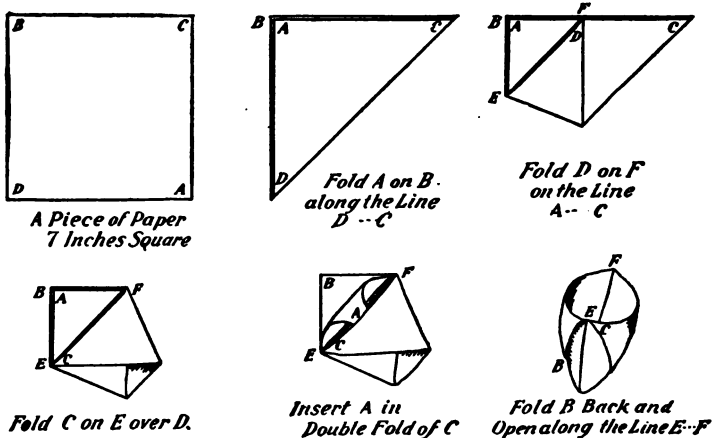


Fig. 66.—How to make a paper drinking cup.

disease germs not only from milkers and people at the dairy but also from the cow itself, since cows often suffer from tuberculosis. The way to make milk absolutely safe is to **pasteurize** it. This word, as you would guess, comes from the name of Pasteur. Pasteurizing milk means that it is heated to a temperature a little below boiling and kept hot for about half an hour. If this is done carefully, any disease germs will

surely be killed, without harming the taste of the milk. In most cities you can buy good pasteurized milk; but where you cannot, the milk can easily be made safe at home. The bottle of milk should be set in a deep pan of water, and the water should be heated just to boiling. Then let the pan stand for half an hour, after which the milk should be taken out and quickly cooled.

Not all the foods we eat can be made safe by cooking. In fact, it is quite necessary for our health that we should eat some raw foods, since cooking destroys certain food substances the body needs. Raw foods—lettuce, celery, apples, pears, and the like—should be carefully washed before eating.

The Care of Cuts and Wounds.—The Greeks might have entered Troy, not through the gateway, but through a hole in the wall, if they could have found one. Just so, harmful microbes may get into our bodies through a cut or a wound anywhere on the surface of the body. The skin is like a wall which keeps the microbes out; but if it is broken, there is always likely to be trouble. When you cut yourself in any way, the place should be washed with clean warm water and then protected from dirt by a clean gauze bandage. If the cut is a bad one, it should be dressed as quickly as possible by a doctor; but if it is a little one and your mother has taken a Red Cross course, perhaps she can put a little iodine on and then dress it herself. In any case, the place should be watched carefully. If it becomes painful and red and angry, it means that danger-

ous germs are growing there, and the doctor should be consulted immediately.

Of course, you children who have been learning about microbes would never think of picking at a cut or a scab of any kind, because you will understand how easily such picking may infect the wound with just the kind of germs you want to keep out.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Tell the story of the way in which the Greeks took the city of Troy.
2. Explain what the wooden horse of Troy has to do with the spread of the germs of disease.
3. Describe some of the ways in which disease germs are carried from one person to another.
4. Think of all the things you have touched with your fingers since you last washed your hands. Could any of them have been soiled with material containing the germs of disease?
5. How often should you wash your hands? Why?
6. George did not want to wash his hands before lunch because they looked perfectly clean. Explain why he was wrong.
7. What are some of the things we should be careful about, in buying and keeping foods?
8. How can milk be pasteurized? What does pasteurization do to the milk?
9. Susan was constantly borrowing pencils and other things from the children near her in school, and she had the bad habit of putting everything she handled into her mouth. Her teacher said, "That child is a danger to every other child in the room." What did she mean?
10. What should be done when you cut your finger? Why?

CHAPTER XVI

SOME UNDESIRABLE NEIGHBORS

The Fly Family.—When the flies buzz about on the window pane and tickle your face in the early morning and bother you at mealtimes by running over the sugar and getting into the jug of cream, did you ever wonder where they come from? They are neighbors of ours and often uninvited guests in our houses and at our tables. We ought to know a little about their habits, so that we may find out whether they should be welcome guests or not.

Mother Fly has quite a large family, a hundred or more children at a time. She lays her eggs—tiny white eggs so small that you can just barely see them—in horse manure about stables if she can find it, or in almost any kind of decaying material. Then she flies away. In about a day the eggs break open, and out of each one comes—what do you suppose—a little fly? Not at all. There comes out of each egg a tiny white worm (just as there comes from the egg laid by a butterfly, not a butterfly but a caterpillar).

The fly maggot or *larva*,¹ as the little worm is called, crawls about in the manure and feeds upon it. It grows and thrives on this unpleasant food, till after four or five days it is about three-eighths of an inch long.

¹ A single maggot is called a *larva*, more than one, *larvæ* (lär'vê). *Pupa* is pronounced pū'pā; and *pupæ*, meaning more than one, is pū'pē.

Then it burrows down into the ground underneath, or out into the dry edges of the manure pile, and there its

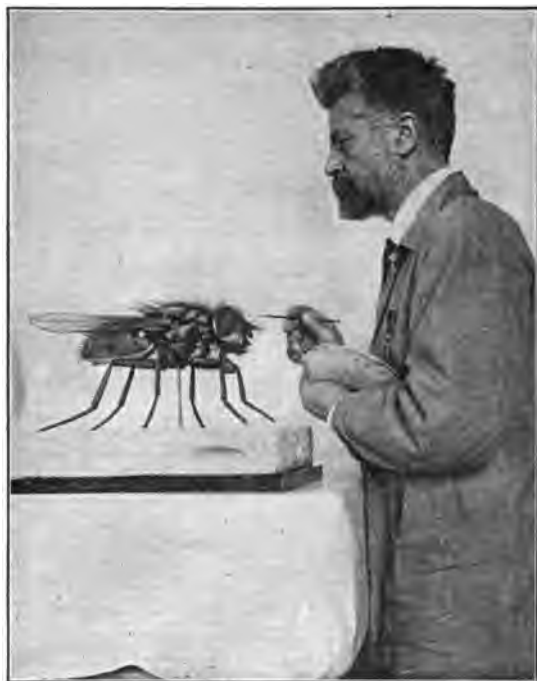


Fig. 67.—The giant model of a fly in the American Museum of Natural History, New York. The artist who made the model is putting the finishing touches to his work.

skin splits open and uncovers a little brown thing like a seed, which is called a *pupa*.¹ In just the same way, as perhaps you may have seen, a caterpillar (which is the larva of a butterfly) changes into a pupa.

¹ See Note on page 179.

Inside the pupa case, the young fly sleeps for four or five days more. At last the brown pupa skin splits, just as the skin of the larva did, and there comes out a full grown fly, just like its mother. It wriggles up to the air and soon flies away, to seek out your sugar bowl or cream pitcher and have a meal.

Is the Fly a Good Neighbor?—Now that you know the history of the Fly children, I think you can make up your mind for yourself whether they are desirable guests at the dinner table or not.

A fly's feet seem quite dainty and small. If you looked at them under a microscope, however, you would see that they have claws and soft sticky pads on the end (by the use of which the fly can walk on the wall or ceiling just as easily as on the floor). On these claws and pads there is plenty of room for microbes. It has been found, by the men and women who study germs, that thousands of microbes are actually carried by these tiny feet from the filthy places where flies live. It is not pleasant to think that even one fly has been tracking his dirty feet over our food. Worst of all, however, is the fact that every now and then the fly has been walking where there were germs of some special disease like typhoid fever; and if these germs are carried to the food, an outbreak of disease is very likely to result.

Little babies often suffer in summer from diseases of the intestines. Studies made in New York City showed that half of this kind of sickness could be prevented by keeping flies out of the baby's room and away from its food.

Fighting the Fly.—From these facts you will realize that in every town and every school and every household there must be a vigorous fight made against the Fly Family.

Sometimes people who want to get rid of flies try to do it by killing them by hand.



Fig. 68.—If you think where the fly may have been last, you will want to keep him away from the dinner table.



We hear now and then about a "Swat-the-Fly" campaign. Fly killers are often useful to get rid of the

flies that are actually in our houses, though sticky fly paper is generally more effective. But we can never destroy all the flies indoors if they are coming in freely from the outside. So doors and windows should all have tightly fitting screens in summer; and remember that a screen door is not very useful if it is held open while a child stands on the step and talks to some one outside—as I have seen some children do.

A great many flies can be caught in traps. A fly trap is usually a cage of wire netting, which has inside a cone of wire, with a large opening at the bottom and a small opening at the top. Underneath the lower opening of the cone is placed a bait of some food that flies like. The flies which come to feed on this bait will fly and crawl up through the cone into the cage. Once inside, they do not know enough to find the hole and get out again.

The best way of all to fight against the Fly Family is to prevent the fly babies from growing up at all in the neighborhood of our houses. If stable manure is kept in tight covered bins, and if refuse of all kinds is cleared away from back yards and open lots, there will be no places for flies to breed.

Mrs. Mosquito and Her Habits.—There is another summer neighbor of ours whom we ought to know something about, and that is Mrs. Mosquito, who buzzes about our beds at night and gives us the bites that itch and sometimes smart so painfully.

Mrs. Mosquito is much more cleanly in her habits than Mrs. Fly. When she starts her family off in life, she seeks, not a manure pile, but a pool of stagnant water, or a slowly running stream half choked up with weeds, or perhaps an old rain barrel, or even a tin can in the back yard in which a little rain water has collected. She lays her eggs on the surface of the water, for her babies live in water, as Mrs. Fly's children live in decaying matter. The larvæ which hatch out from Mrs. Mosquito's eggs are little brownish creatures with

tufts of hair on their bodies. They are often called "wigglers," because of the way they swim about in the water by jerking their bodies from side to side.

After a week or so these larvæ, like those of the fly, change to pupæ. The mosquito pupæ are not motionless like the fly pupæ. They can still jerk themselves about in the water. They do not eat, however, but rest quietly at the surface, unless they are disturbed. After a few days they change again. The pupa skin splits up the back and the grown-up winged mosquito comes out. For a few minutes it stands on the old pupa skin to dry its wings and then it flies away.

Why Mosquitoes are Dangerous.—We all know that mosquitoes are a nuisance because they sting us and keep us awake at night. You might not think they would do any harm, however, since they breed in pools and streams instead of in dirty places as the flies do. Yet some kinds of mosquitoes are even more dangerous than flies in spreading the germs of disease.

In many parts of the United States, and in most of the warmer countries of the world, a disease called **malaria** is common. The germ which causes this disease lives in the blood and attacks the red cells, which carry oxygen to the different organs. This germ is carried from one person to another by a mosquito. The insect bites a person who has the malaria germ in his blood. In sucking out the blood, the mosquito sucks out also some of the malaria germs. Then it bites a second person and introduces the germ into his blood, giving him the disease in turn.

Long ago it was noticed that malaria was generally found in the low lands near streams and swamps, and people thought there was something mysterious in the air of such places that caused the disease. Now we know that what made the air unhealthful was simply the mosquitoes which were flying in it; and the reason why malaria occurred near swamps was because there was stagnant water there in which mosquitoes could breed.

Only certain kinds of mosquitoes can carry malaria in this way; and you can easily tell the dif-

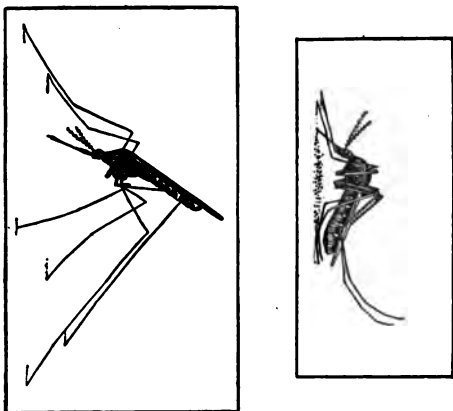


Fig. 69.—Resting position of the common mosquito (right) and the malarial mosquito (left).

ference between the malarial mosquitoes and the ordinary kinds. The wings of the malarial mosquitoes are spotted, while the wings of the commoner kinds are not. The position of the malarial mosquitoes, when resting on the wall, is different, too. They hold their bodies out in a straight line from the wall, while the common mosquitoes sit in a sort of hump-backed position, as you can see by looking at Fig. 69.

Even the larvæ of these two sorts of mosquitoes can quite easily be distinguished. The larvæ of the malarial

mosquito, when they are at rest in the water, lie flat against the surface, while the larvæ of the common mosquito hang at an angle with the surface, their tails only touching it.

How to Get Rid of Mosquitoes.—Screens will help to keep mosquitoes, as well as flies, out of our houses. But with mosquitoes, as with flies, the best thing to do is to prevent the insects from breeding at all. We can do this by draining the marshlands, by digging ditches through which the water can flow out instead of standing in little pools. We can clear small streams of weeds and grass so that the water will run rapidly, for Mrs. Mosquito will not lay her eggs in water that is flowing fast. We can empty our old barrels and tin cans and all such collections of water, so that there may be no place where the little wigglers can live.

Sometimes when it is not possible to drain away marshy pools in which mosquitoes might breed, oil is sprayed over the pools. As oil is lighter than water, it spreads out in a very thin layer over the top and kills the mosquito larvæ. The breeding of mosquitoes may often be stopped by putting fish into a pond, for many kinds of fish will eat up mosquito wigglers (see Fig. 70).

How America Built the Panama Canal.—One of the great things our country has done, of which all Americans are proud, is the building of the Panama Canal. You have probably learned in your geography about this famous canal, which cuts through the Isthmus of Panama between North and South America and makes it possible for ships to pass directly from the Atlantic

into the Pacific, without going all the way around Cape Horn, as they used to do.

Long ago the French tried to build a canal across this isthmus. One of the chief reasons why they did not succeed was that their workmen fell sick of malaria and other diseases, and particularly of one very terrible



Fig. 70.—Goldfish eating mosquito wigglers. These two fish destroyed 98 wigglers in four minutes.

disease called yellow fever. No one knew at that time what caused either malaria or yellow fever, and there was therefore no way to protect the people who tried to live and work in warm countries, where these diseases prevailed.

At last it was found out that malaria, as we have seen, is spread by the bite of a certain mosquito. A group of American army doctors, headed by Walter Reed,

then went to Cuba, where yellow fever was common, to try to learn how to control it. They soon proved that yellow fever, too, is spread by a mosquito, but by a different kind from the one that carries malaria.

That sounds very simple, perhaps; but it was not at all an easy thing to prove. The doctors suspected that a special kind of mosquito carried the germ of yellow fever. It was necessary to let these special mosquitoes first bite people sick with yellow fever, and then bite other well people, and see whether these well people would become ill. It was a brave thing to do, to take an almost certain risk of getting such a disease—as brave as anything our soldiers have done in the trenches in France. The men who were bitten by the mosquitoes which carried the germ developed yellow fever, and one of them, Jesse W. Lazear, died of it. By their heroism, they showed the world how yellow fever was really caused, and therefore how it could be controlled.

It was soon after this that the United States began its attempt to build the Panama Canal. In view of the discoveries made in Cuba, it was clear that it was the presence of mosquitoes which made Panama such a dangerous place. So Dr. W. C. Gorgas (who later became the head of the Medical Corps of the whole United States Army) was sent to Panama and placed in charge of a campaign against these insects. He was so successful that he wiped out yellow fever on the Isthmus, and nearly abolished malaria as well. The great canal was built; and one of the chief things

that made it possible to build it was the knowledge of how to control yellow fever and malaria.

Other Insect Bearers of Disease.—There are many other insects which may spread the germs of disease, particularly in the warm countries of the Tropics. In the trenches and in overcrowded army camps, there are sometimes diseases caused by lice—diseases which used to be very common everywhere in old times, when people did not keep as clean as they do nowadays. It is important that the greatest care should be taken always to keep the head and body and clothes clean, so that these dangerous insects may not find a chance to develop.



Fig. 71.—William Crawford Gorgas, conqueror of yellow fever and malaria at Panama; Surgeon General of the United States army.

How Children can Help to Fight the Mosquito and the Fly.—Children can do many things to help in the fight against the mosquito and the fly. Every good citizen is anxious to rid his neighborhood of these pests, but older people are often too busy to hunt about and

find out where their breeding places are. Boys and girls, with a little help from their teacher or some other older person, can soon learn to recognize fly maggots and mosquito wigglers. Then they can organize scouting parties to find the manure piles and rubbish heaps where the flies are developing, and the pools and rain barrels and other places from which the mosquitoes come.

If Boy Scouts or other groups of children will hunt out the insect pests in this way and report to their scoutmaster or parents or teachers where the trouble lies, the breeding places can often be done away with and the whole neighborhood made pleasanter and safer to live in.

An Evening Talk.—One evening in midsummer Mrs. Mosquito was sitting on the wall of the barn, just under the eaves where it is warm and pleasant. All at once there was a great buzzing, and Mrs. Fly came flying along and settled down beside her, very much hurried and out of breath.

"Good evening, my dear. You seem a little flustered," she said to the newcomer politely, "Is anything the matter?"

"Everything is the matter, indeed," replied Mrs. Fly in a tone of bitter disgust. "I have just been chased out of the house by a little girl with a fly-killer. I don't mind that so much, because she never could get near me. I took care of that. But inside the house every single bit of food was covered so that I could get nothing to eat. The lid was on the sugar bowl and a napkin over the top of the cream pitcher."

"It's too bad," Mrs. Mosquito answered feelingly. "I have had a hard time, too. I have been looking all day for a good place to lay my eggs so that my babies could grow up happily, and if you will believe it, I could not find a single one. The swamp behind the barn has been drained, and there is a tight

cover on the rain barrel, and these wretched Boy Scouts have even taken away the old tins by the fence at the end of the orchard, which used to be full of water after every rain. Life is very difficult nowadays."

"Yes, and it's all the fault of those same Boy Scouts," broke in her friend, still bursting with indignation. "They found some of my brothers and sisters feeding



Fig. 72.—Mrs. Fly and Mrs. Mosquito decide that Cleanville is no place for them.



quietly and peaceably in the manure pile. They told their father about it, and now he keeps the manure in a tight bin. And they have cleaned up the rubbish pile at the end of the gar-

den. Mrs. Mosquito, this is no place for a poor insect to get a living any longer. Let us move to the next town and see if things are not better there."

"I believe you are right," said Mrs. Mosquito. "I believe you are right. Cleanville has no attraction for insects any longer. We will leave it to the human beings, and we will carry our malaria and typhoid germs to some other place, where the people are kinder and more hospitable." .

So they flew off together through the twilight; but everybody else in Cleanville said that the Boy Scouts had been doing a good summer's work.

QUESTIONS FOR DISCUSSION AND REVIEW

1. What stages does the fly pass through before it becomes full-grown?
2. What harm may a fly do by walking over a slice of bread on the table?
3. In some neighborhoods there are always a great many flies in summer, and in others there are scarcely any. What do you suppose is the reason for this?
4. How does a fly trap work?
5. Why does malaria occur in swampy regions?
6. Through what stages does a mosquito pass before it becomes full-grown?
7. How can you tell a malarial mosquito larva from the common kind? How can you tell a full-grown malarial mosquito from the common kind?
8. When are mosquitoes likely to be most common: in a rainy summer or a dry one? Why?

9. Give one reason why America succeeded in building the Panama Canal while the French failed.

10. Who discovered how yellow fever is caused? How was this discovery made?

11. How can you help next summer in fighting against insect-borne disease?

CHAPTER XVII

STOPPING THE SPREAD OF GERM DISEASE

Button, Button, Who's Got the Button?—You must sometimes have played the game in which a button is passed about a circle of children from one hand to another, while a child in the center tries to guess where the button is.

The spread of germ diseases in a family, or in a school, or in a city, is somewhat like this game. A person who is coming down with the disease, or is a carrier, brings in the germs and passes them on to some one else, and so it goes on from one to another. Only there is this difference. You can pass the button to only one person at a time. The disease germs, on the other hand, are constantly growing and increasing in numbers, so that they may spread from one person to half a dozen others, and from each of these to half a dozen more.

If the first boy who had the button put it into his pocket and kept it there, instead of handing it to any one, there would be an end of the game. In the same way, if the first child who is coming down with a disease were prevented from passing his germs on to some one else, there would be no more of that special kind of sickness among his friends and schoolmates. This is just what the Board of Health is always trying to do: to find cases of germ disease and take care of

them so that the germs may not spread to someone else.

How to Prevent the Spread of Disease Germs.—In unusual or very deadly diseases, like smallpox and plague, the sick person is taken to a special hospital, where he can be cared for without danger. In most diseases, however, it is proper for the person to stay at home, if he can be kept in a separate room where no one goes, except his mother or nurse or whoever takes care of him.

Everything that comes out of this room which may contain the germs of the disease, such as bedclothes, handkerchiefs, forks and spoons, glasses and cups, should be boiled in water to kill the germs. The person in charge of the sick room should take the greatest care always to wash her hands thoroughly with warm water and soap, or with a special solution provided by the doctor to kill microbes. Otherwise, she may easily carry the germs on her hands to the rest of the family.

A child may often have diseases like whooping cough or an ordinary cold in the head, without being sick enough to be in bed or even shut up in the house. In such a case, the child himself is the one who must try to protect other people, by taking care that the discharges from the nose and throat are not passed along to others.

Wherever a case of a germ disease occurs, the Board of Health puts up a placard at the door of the house or of the apartment, to warn people that there is

danger inside; and every one should of course keep away from a house where such a placard has been posted.

Danger Signals.—Most germ diseases are particularly “catching” just at the beginning, before the child or older person feels sick enough to go to bed and send for the doctor. We ought to be on the watch for the early signs of such diseases, either in ourselves or in other people, just as the players in the button game watch each other to see the conscious look on the face of the one who has the button in his hand.

Here are some of the signs of the beginning of an attack of a germ disease:

Coughing	Watery eyes
Sneezing	Headache
Running nose	Rash or spots on the skin
Sore throat	Weak, tired feeling
Hot, feverish feeling	Vomiting

On a railroad track the train men sometimes hold out a red flag, or at night a red lantern, to warn a coming train that the track is not clear and that the train must stop. Any one of the things in the list above is a warning sign that something is wrong, like the red flag held out to stop the train.

These signs generally mean a cold in the head or a sore throat which will probably be over in a few days. They may, however, mean something more serious, like influenza or scarlet fever. So we should keep away, as much as possible, from any one who shows any of these signs of sickness.

Watching People Who have been Exposed to Germ Diseases.—Particular care should be taken to watch people who have been exposed to a germ disease—people, that is, who have been near a sick person and are therefore very likely to have taken the germs into their bodies.

When you catch a disease, like measles, from some one else, you do not come down with it right away. For a few days or perhaps a week or so, nothing happens at all, as far as any one can see; and then at last the coughing or the sneezing or the running nose or the fever

begins. All the time something was really going on; the germs were growing and multiplying in your body until there were enough to make you feel really sick.

The doctors know how long it takes for the germs of



Fig. 73.—The Board of Health has placards posted to warn everyone away from a house or an apartment where there is a dangerous case of communicable disease.

each disease to develop in the body in this way. In many cases the Board of Health makes children who have been exposed to a germ disease stay out of school and away from other children, until this time is over and it is certain that they are not coming down with the disease themselves.

Keeping Disease Germs out of the Schoolroom.—Many of the commoner germ diseases are particularly likely to affect children, and so it is very important to keep such germs out of the schoolroom, where they may do so much harm. The simplest way to do this is to watch carefully for children who are coming down with some sickness and to send them home.

In most cities there are school doctors and school nurses who are always on the look-out for such signs of disease. It is their duty to examine any children whom the teacher may think are not well, to see if they have a germ disease and if they should be kept out of school until they are no longer dangerous to others.

Your Own Responsibility about Germ Diseases.—You children who are studying this book are old enough to know what *responsibility* means. I am sure you all try not to do anything that may hurt any one else needlessly. Now all of us, children and grown people alike, have a *responsibility* about the spread of germ diseases.

You can never tell how much harm may come from the passing on of the germs of disease from one person to another. What is only a little cold in the head in one may prove very serious in another. So if you have any

of the signs of the germ diseases mentioned on page 196, you ought to take the greatest care not to expose other people to any danger. That means that you ought not to go to school (unless the school doctor says it is all right to do so) or play with other children. In your own family, you ought to take pains not to cough or sneeze in other people's faces, not to kiss or fondle other people, and not to touch food they are to eat or things they are likely to handle.

Above all, if you are ill, you should take the greatest care not to play with babies or very young children or to go anywhere near them. Germ diseases are much more serious for babies than for older people. "A little cold in a big person may be a big cold in a little person," some one has said; and it is a very true saying.

Why Alfred did not have the Measles.—Alfred was a baby about eight months old, and Anna, his elder sister, who often took care of him, thought he was a very cunning baby indeed.

One day she heard her father say to her mother, "Do you know that there is a great deal of measles about? I hope the baby does not catch it. He is so delicate that it might go very hard with him." Anna made up her mind that he should not be sick if she could help it.

When she took Alfred out in his carriage, she was very careful to keep away from houses which had the Board of Health sign MEASLES on them, and not to stop and speak to any children she knew, if they were coughing or sneezing. One day as she was passing the home of her friend, Ellen Ramsay, she saw Ellen sitting

on the doorstep looking rather miserable and using her handkerchief a great deal.

"Hullo, Anna," she cried out, "come in and play with me. And let me hold Alfred for a little while. I think he's very cute."

"No, I don't dare to," replied Anna, backing away.



Fig. 74.—"No," replied Anna, "I am not letting anyone come near him for fear he will get the measles."

"I'm not letting any one come near him, for fear he should get the measles."

"Oh, come on! I haven't anything but a little cold."

"You don't know whether you have or not, Ellen, and I'm going to take the baby away, to be sure. Good-by. I hope you'll feel all right to-morrow."

"'Fraid Cat, 'fraid Cat," sang out Ellen; and as Anna went on up the street, the tears came into her

blue eyes, for she knew she was not afraid for herself and it was hard to be called a coward.

About two weeks later Anna heard her father and mother talking about the measles again. "Do you know the whole Ramsay family have it? And the baby is very sick. They fear it may not live. Ellen got it first and gave it to all the rest. It's lucky Alfred has escaped, isn't it?"

Anna never told them it wasn't "luck" at all, but her own good sense and the courage to do what she knew was right, that had saved Alfred.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Compare the game of "Button, Button, Who's Got the Button" with the spread of a germ disease.
2. What precautions should be taken by a person in charge of a child sick with scarlet fever, so as to prevent the disease being carried to others?
3. Make as long a list as you can, from memory, of the common signs of the beginning of an attack of a germ disease.
4. Susan had measles. Her brothers were perfectly well, but they were kept out of school for two weeks. Why?
5. How do the school doctor and the school nurse help to prevent outbreaks of disease in schools?
6. What are some of the things you should be careful about when you have a cold? What may happen if you are not?
7. Tell the story about why Alfred did not have the measles.
8. Patrick had a sore throat and a headache and felt feverish. He was an ambitious boy, however, and wanted to go to school just the same. Was he right? Tell what might happen if he did.

CHAPTER XVIII

THE ARMY OF HEALTH

An Army to Fight Disease.—When a nation goes to war, it must depend for safety upon its army and navy. The soldiers and sailors have been trained to fight the enemy on land and sea, and their officers have studied the business of war, so that they know how the campaign should be carried on and just how the forces of the nation can be used to most effect.

In peace time and in war time, too, there is always a fight going on against the microbes that cause disease. Do you know about the special army that fights this war?

There is such an army, an army of men and women who spend their lives in protecting you and me from our invisible foes. They are the men and women employed by the Boards of Health of town and city and state and by the United States Public Health Service at Washington.

In a war, every good citizen must do all he can to help the government. The army and the navy alone cannot win, if men and women all over the country are not doing their part, by making guns and building ships and growing grain and helping the Red Cross and buying Liberty Bonds and War Savings Stamps.

It is just the same in the war against disease. The

Board of Health cannot keep us safe, if we do not help by doing our part, every one of us. We are going to learn in this chapter about some of the things that the Board of Health is trying to accomplish, for we cannot help if we do not understand something about the tasks of the health officer and his doctors and nurses and inspectors.

Keeping the City Clean.—One of the things that the Board of Health has to do is to see that the city is kept clean. If there is a heap of decaying refuse in a back yard, for instance, or if there is a broken drain in the cellar, a letter or a telephone call should be sent to the Board of Health. An inspector will come and see what is wrong; and if the condition is harmful, he will have it remedied.

Many conditions of this kind, with which the Board of Health must deal, have really very little to do with health. They are merely things that from their smell or their appearance are offensive. Such things are called **nuisances**. On the other hand, some nuisances are very important indeed from a health standpoint, such as badly built open closets, manure piles which may breed flies, and pools of stagnant water which may breed mosquitoes.

The Board of Health does not wait to be called in by the complaints of the citizens. Its men are all the time on the lookout for bad conditions, either indoors or out. They are constantly visiting tenements, schools, factories, and theaters, to see that they are well lighted and have plenty of fresh air, and that there are no

conditions dangerous to the health of those who use them.

Where the Water Comes from and Where It Goes.—

If you live on a small farm, you probably know very well where the water comes from. Perhaps you have to go out sometimes and draw it from the pump and bring in a pailful. If you live in the city, however, you have very likely never thought about it at all. When you want some water, you just turn on the tap and never think how the water always happens to be there, ready to flow out when you need it.

The water for a city comes from some lake or river or from large wells. It is often necessary to go many miles away to find the water, and to build great pipes to carry it to the city. The water for New York City, for instance, is brought in a water pipe so big that a large motor truck could easily drive through it (see Fig. 75). When such a pipe reaches the city, it branches into smaller and smaller pipes that run underground through the streets, and on at last to your house and up to your bathroom. Some one must see to the building of this water system, and some one must watch it all the time to see that the water is pure and good and that nothing harmful or poisonous gets into it.

Besides the water pipes, there is another set of pipes in the streets, to carry off the waste water after it has been used. They are called **sewers**; and these, too, must be laid carefully and kept in good repair. The dirty water that flows in them, called **sewage**, must

be disposed of in some way, so that it will not create a nuisance or endanger health.

Guarding Our Food Supply.—Other foods, as well as water, must be carefully watched, so that they may not carry the germs of disease. So the Board of Health



Fig. 75.—A section of the great pipe or aqueduct which brings drinking water into New York City, in process of construction.

sends men out to see that everything is clean at the farms from which milk is sent in to the city. Other men inspect the stores where milk is sold, and the stores where all other kinds of food are sold, to see that they are kept in good condition and that no people who are sick with germ diseases are allowed to handle the milk or the other foods.

Caring for Those Who are Suffering from Germ Diseases.—Above all, it is the duty of the Board of Health to watch over the people who are actually suffering from germ diseases, so as to prevent, if possible, the further spread of the germs. As soon as a doctor finds that one of his patients has a disease of this kind, like diphtheria or scarlet fever or measles or whooping cough, he reports it at once to the Board of Health. The Board of Health then sees that the case is cared for, so that the rest of the family and other people outside will not be in danger.

In the case of many of these germ diseases, the Board of Health can supply the doctor with special preparations, called **vaccines** and **sera**, which will cure or prevent disease of this kind. One of these preparations is smallpox vaccine, which is rubbed into the skin of the arm to prevent smallpox—once a very common and terrible disease. Every child ought to be protected by smallpox vaccination. In the same way, older people can be protected against typhoid fever by typhoid vaccine. Any one who is so unfortunate as to catch diphtheria can be cured by the use of another of these preparations, called diphtheria **antitoxin**.

The War against Tuberculosis.—There is one germ which is such a very serious enemy of mankind that the Board of Health has special officers trained to fight against it. This disease is **tuberculosis**. It is a long word, but every one should know something of what it means.

The germ of tuberculosis lives most often in the

lungs. The person who has the disease generally grows weak, thin, and feverish and has a cough. The germ is coughed up and spit out, in getting rid of the matter that gathers in the throat. One way of stopping the spread of tuberculosis is by teaching people who have this disease not to cough or spit carelessly, and teaching other people not to put into their mouths things that may be soiled with these germs.

Another very important way of stopping tuberculosis is by helping people to keep their bodies in a generally vigorous state of health, so that when the germ of tuberculosis does come along, it cannot gain a foothold. This germ is not really a very powerful one, and a person who is in thoroughly good health very rarely has this disease at all. It is people who are tired out or have had some other sickness, or those who do not have enough to eat, who catch it. Even people who have caught it can generally get well again, if they lead a thoroughly healthy life.

The Board of Health in many cities tries to teach every one about this disease, so that all can be on guard against it. It provides special places, called **dispensaries**, where people who feel unwell or have a cough can go, to see if they have tuberculosis. It also provides special hospitals, where people can be cured. If a person can find out at the beginning that he has this disease, he can almost always get well under proper care. He may have to go to a hospital; or he may be able to stay at home, if he does just what the doctor orders and has plenty of fresh air and rest and

good food. It is only when the disease has gone too far that it is dangerous; and since people found this out, the fight against tuberculosis has gone on steadily and successfully.

Guarding the Health of School Children.—Almost all diseases are like tuberculosis in this: that they are most easily cured at the beginning, before the trouble has gone very far. If you make a hole in your stocking, it will be easy for Mother to mend it at first. If you let it go for several days without telling her, it will get bigger and bigger, and finally perhaps there will be nothing to do but to throw the pair of stockings away. It is just so with diseases. At first, the trouble can generally be cured; but if you wait too long, it may be too late.

This is why the Board of Health (or in many cities the School Board) has doctors and nurses in the schools to examine the children. These doctors and school nurses test the children's hearing and their eyesight, and look at their teeth and their throats, to see if anything is beginning to go wrong and ought to be remedied.

Every child ought to see clearly, near by and at a distance, to have keen hearing, to sleep soundly and eat heartily, and to be full of the feeling of health and vigor. If you are not like this, if you have headaches or frequent colds, or sensitive teeth, there is something wrong. It is probable that the trouble can easily be remedied. In such a case, your mother should have a doctor see you, or your teacher should have the school doctor see you, for almost all children can be well and

vigorous, if little troubles are cured at the beginning and if the right habits of life are formed.

The Public Health Nurse.—You children will prob-



Fig. 76.—Children who have tuberculosis can generally be cured by going to a sanatorium where they can live most of the time outdoors and be under proper medical care.

ably go to school for several years more and will be learning new things all the time. When you finally leave school, perhaps you may think you know all there is to know! This will not be so—not even if you go to high school and college, and go on studying till

you are a full grown man or woman. There will always be new things to learn; and the wise person keeps on learning as much as he can all through his life.

This is particularly true in health matters. New and better ways of fighting diseases and keeping people healthy are being found out all the time. So perhaps the most important of all the things the Board of Health does is to teach—not only children in the schools but grown people, like your fathers and mothers,—how to keep well.

The Board of Health does this by lectures and exhibits, by printing and giving away leaflets, and in many other ways. Perhaps the best way of all is by means of Public Health nurses. These nurses go out through the city, showing the people with germ diseases what they can do to keep from giving the diseases to others. They show the people with tuberculosis how they ought to take care of themselves, in order to be cured. They show the mothers just the best way of taking care of their young babies, so as to keep them well. The Public Health nurse is one of the most efficient officers in the army that fights against disease.

Janet's Argument.—Janet lived in a small city called Healthville, and her Uncle Jim and his children lived in a much bigger city, Richtown, about an hour's ride away on the train. Janet was very fond of her cousins and was delighted when she heard they were coming to pay her a visit. It seemed a long time till they arrived, and you may be sure she was all ready and

watching at the door when Uncle Jim and the two little girls came up the street.

As soon as the visitors had come in and taken off their things, they sat down to talk, for Janet's mother and father had not seen Uncle Jim for a long time. He explained that there was a very bad epidemic of diphtheria in Richtown, so that all the schools had been closed; and that he had brought the children for a long visit, until the epidemic was over and it was safe to take them home.

Janet and her cousins were so happy in thinking of the good times they were to have together, and so busy in planning for all the things they were going to do, that Janet did not hear what the grown-ups were saying for a long time. When she did listen again, Uncle Jim was talking, as he often did, about what a fine place Richtown was. This was one thing about Uncle Jim that Janet never liked; for she thought Healthville, where she lived, was the nicest place on earth.

"We have just built a new hotel, fourteen stories high and fireproof," Uncle Jim was saying. "With the Opera House opposite, the Central Square is a fine sight. Now that we have the Carnegie Library and the new High School and all the Parks and Boulevards, there isn't a finer city in the whole Middle West."

"Well, there's one thing we have in Healthville that's better than Richtown, Uncle Jim," said Janet eagerly.

"What's that, child?" he asked smiling, as if he was quite sure she was mistaken.

"Our Board of Health," answered Janet. "You have so much diphtheria that your fine schools are all closed. But our teacher told us our Board of Health was so good that there hadn't been a case of diphtheria in the school in five years. Libraries and opera houses aren't any good if you are sick; and if you are well, you can have a good time anyway."

QUESTIONS FOR DISCUSSION AND REVIEW

1. What are some of the duties of the Board of Health?
2. Why are badly built outside closets, manure piles, and pools of stagnant water dangerous from the standpoint of health?
3. See if you can think of any nuisances in your town that ought to be called to the attention of the Board of Health.
4. Find out, if you can, where the water supply of your school comes from.
5. What are vaccines and sera? Give three examples of diseases in which they are useful.
6. How can tuberculosis be prevented?
7. Is there a school doctor or a school nurse, or both, in your school? If so, what do they do?
8. Why do even grown people have to keep learning all the time about health matters?
9. What do you think of Janet's argument about the superiority of Healthville?
10. If Janet was right, what is the most important thing any town can do for its citizens?

CHAPTER XIX

SOME RULES FOR HEALTH

The Dream of John Paul Jones.—One of the most famous figures in the War of the American Revolution was John Paul Jones, the first of America's naval heroes. He was born in Scotland, the son of a gardener. There is a story that, in his boyhood, he was one day lying on a rock in the warm sun after a swim in the ocean. He fell asleep and dreamed a curious dream. He dreamed that he was the captain of a ship and was fighting a great naval battle. Guns were roaring, the air was full of smoke, and on the mast over his head floated a strange flag with red and white stripes on it and stars in a square in the corner. He told a friend, an English naval officer, about this dream. His friend replied that he hoped John Paul might some day command a ship, but that it would not be under such a flag as he described because there was no flag like that in the world—and there was not at that time.

John Paul loved the ocean, and he went to sea as apprentice, or helper, when he was only twelve years old. Before he was twenty-five, he became captain of a merchant ship. In 1773, two years before the War of the Revolution, he came to America and made his home in Virginia. He saw, as many people did, that the American states (at that time colonies of Great

Britain) must soon become independent. It is even said that he told George Washington long before the war began: "Remember, when it comes I shall be ready."

When the war did come, John Paul was indeed ready. He was placed in command of a small fleet of American and French ships, with which he fought most gallantly against the British. His greatest battle was that in which his ship, the *Bonhomme Richard*, vanquished the *Serapis*. According to the story that some people tell, the captain of the *Serapis* was the very man to whom John Paul had told his dream many years before. If so, he must have been surprised to be beaten by a ship flying the very flag that little John Paul had dreamed about so long ago, while the United States were still under the British flag.

Serving the Stars and Stripes.—I do not suppose any of you have had a dream just like that of John Paul Jones. I think, however, that many of you must have had some sort of dream of serving your country and your flag. You have seen the Stars and Stripes flying from almost every house, and have thought of our soldiers fighting under that flag in France, and have planned that when you grow up you will do great things for your country, too. Even if it is never necessary for you to fight or to nurse the wounded in war, your country will need your loyalty and your devotion, to do her work in peace and to help with all your might to make the United States of America a greater and a nobler and a better country.

When John Paul Jones saw the war coming, he could tell Washington that he was "ready." That is what your country wants you to be to-day, ready for what-



Fig. 77.—The motto of the American boy and the American girl is "Preparedness for our country's service."

ever she may call you to do. She wants you to be ready in heart: unselfish, devoted, brave, fair, honest. She wants you to be ready in mind: quick, thoughtful, well trained, full of knowledge. She wants you to be

ready in body: strong and sound and full of abounding health.

Do not think of health, then, as just something for yourself. If you lived alone on a desert island like Robinson Crusoe, you might have a right to say, "Oh well, I don't care. I'd rather have indigestion or catch cold than bother." As it is, you are a part of your country. Think of the Stars and Stripes and what you can do for the flag when you grow up. Be ready, as John Paul Jones was ready, when your country needs you.

Keeping the Body Fit.—Let us see what the most important things are that you ought to do, in order to keep your body strong and well and ready for your country's service. You have learned about most of them in this book, but it will be helpful to set them all down in order here.

1. *Hold Your Body Well.* The first essential of health and strength is to hold the body well, with the back straight and the head high. No good soldier slouches. Stand well, sit well, walk well.

2. *Exercise Your Muscles.* The muscles grow with use. In certain diseases something happens to the nerves, so that a leg or an arm perhaps cannot be used. Such a leg or arm shrivels up and grows small and weak. On the contrary, a child who uses his muscles, grows stronger all the time. Don't be lazy. Exercise till you are tired, and each day you can do a little more than the day before. Learn to swim and to ride, if you can. Learn to play all sorts of athletic games, and partic-

ularly those games, like football and baseball and basket ball, that involve team play and teach you to coöperate with others for the common good.

3. *Keep Your Skin Healthy.* Health, as we have seen, depends in large measure on the condition of the little blood vessels in the skin. Don't sit in a room that is too hot. Don't wear clothing that is too heavy.



Fig. 78.—The boy who learns to swim may be able to save his own life and that of others when an accident occurs.

On the other hand, don't get chilled. Take a cold bath in the morning, if you find that you feel brisk and toned up after it.

4. *Breathe Fresh Air.* Breathe deeply and get plenty of good air into your lungs. Sleep all the year round with your windows open. Play in the fresh air outdoors as much as you can.

5. *Get Sufficient Rest.* Don't forget that your body and your brain need rest as well as exercise. Get a

good long night's sleep, so as to feel fresh and vigorous for the next day.

6. *Eat Wisely.* Learn to like all kinds of good foods, and particularly drink plenty of milk and eat all the fresh fruits and vegetables you can get. Don't eat too much candy or pastry. Eat slowly, and don't eat much between meals. Drink plenty of water. Many children do not drink as much water as the body needs.

7. *Avoid Poisons.* Don't let your body be poisoned by decayed food in your intestines. Have a regular movement of the bowels at least once a day. Remember that tobacco should not be used until you are full grown, if at all, and that alcoholic drinks always do harm.

8. *Keep Clean.* Keep your teeth sound and strong by regular, thorough brushing. Keep your nails and your hair clean and neat.

Guarding against Germ Diseases.—If you follow the rules outlined above, your body ought to be strong and healthy and fit for any service. All the strength and health may disappear in a few hours, however, if the germ of some disease gets in and makes a successful attack. So there are other precautions that you ought to remember, in guarding against these unseen enemies of yours.

1. *Guard the Gateway of the Mouth.* Keep out of the mouth everything that is not clean. That means fingers and everything except clean food and the tooth-brush, for you can never be sure that other things are clean.

2. *Eat Clean Food.* Eat only clean food; that is, food

that has been cooked or thoroughly washed and has not been handled by any one with unclean hands, or by any one who is ill. Do not eat food that is the least bit spoiled.



Fig. 79.—Every Boy Scout must know how to help in case of an accident.

3. *Eat with Clean Hands.* Always wash your hands thoroughly before coming to the table and before eating between meals. Always wash your hands after using the toilet.

4. *Fight against Insect Pests.* Do all you can to help in the war against insect pests. Help to kill flies and

mosquitoes and to do away with the filth and stagnant water in which they breed. Keep flies and mosquitoes out of the house, and keep flies away from food.

5. *Avoid Infection.* Do not run needless risk of catching colds or other diseases by being with people who are ill, unless there is some good reason why you must. Do not kiss people who are ill or handle the things they have handled, unless it is necessary.

6. *See the Doctor in Time.* If you do not feel quite well, ask to see the school doctor. It may save you a serious illness and may safeguard many other people, if you consult the doctor in time. If you do not feel well, keep away from babies and small children, so as to protect them from possible danger.

Accidents.—Accidents sometimes happen to every one, and it is important to know what to do when an accident occurs.

1. *Cinders or Dust Particles in the Eye.* Very often, for instance, a piece of fine dust or a cinder gets into your eye. The most natural thing to do, perhaps, is to rub your eye, but this only makes the pain worse. Sometimes the cinder can be seen on the surface of the eye, and some one can get it out on the corner of a clean handkerchief. Sometimes if the eye is kept closed for a few minutes, the tears will wash it out. Blowing the nose will sometimes help. If the eye still hurts after these things have been done, you should go to some older person and let him try to get the cinder out.

2. *Cuts and Scratches.* Any child who plays as a healthy child should, will sometimes get scratched or

cut. The great thing to remember in such a case is to keep the place clean, so that harmful germs may not get in. If the cut is a little one, it should be washed out thoroughly with clean water and covered with clean gauze. If the cut is a bad one or a deep one, such



Fig. 80.—Prompt treatment of a cut or a sprain or a bruise will often prevent suffering and injury.

as is made by a rusty nail, it should always be dressed by a doctor. The bite of an animal is particularly dangerous, since the teeth of an animal are always dirty. Remember that any scratch, however slight, should be shown to the doctor if it grows red and hot.

3. *Bruises and Insect Stings.* Bruises will be less painful if a cloth wrung out in cold water is placed over

them. Insect stings can be relieved by putting ammonia on them, and, to some extent, by plastering a little wet mud over the place that has been bitten.

4. *Poisons.* You ought to be very careful indeed never to take any medicine, except what your parents or the doctor give you. Never drink anything out of a bottle or anything that some one has left standing in a glass, even if it looks clear like water. Many of the medicines used when people are ill would be deadly poisons if taken by a child, or by any one else, except in just the amount and the way the doctor orders.

5. *Frostbites and Chilblains.* If your fingers or ears or nose should get frostbitten in winter, remember not to go near the fire or into a hot room for a while, as a sudden change from cold to hot makes the pain much worse. The thing to do is to rub the part that has been frozen with snow or very cold water, until the blood has come back and the flesh begins to sting and burn. If you have those painful itching swellings called chilblains, you should never put your feet near the fire or over the register.

6. *Burns.* The best thing to do for a burn is to cover the place with vaseline or with a paste made of baking soda and water. This will make the pain much less.

If a blister forms, don't pick it off and run the risk of getting harmful germs in, but let it heal naturally.

If your clothing should catch fire, don't run, because the air will make the fire burn faster. Lie down and roll on the floor to smother it, and wrap yourself in a rug or coat or shawl, if you can find one. The cloth

should be wrapped *from above down*, so as not to drive the flames up toward the mouth.

Above all, when an accident occurs, *keep cool*. Don't lose your head, but think out the right thing to do and then do it.

Safety First.—We want every American boy and



Fig. 81.—Thousands of children lose their lives every year by playing in the street.

girl to be brave enough to risk his or her life if necessary; but we do not want any one to risk his life carelessly or foolishly.

1. *Street Accidents.* It is not courage but foolishness to run and play in the street in front of automobiles and trucks. Thousands of children are killed in this way every year. Stealing rides, coasting in the street, and roller skating in the street are all dangerous amuse-

ments. Many children do these things and escape, but every now and then one is killed. You may be that one.

2. *Accidents from Fire.* Another thing that children should be very careful about is fire in any form. I hope you never play with matches or make bonfires, unless you are with some grown person, for much damage and the loss of many lives is due to carelessness of this kind.

3. *Accidents in the Water.* Water is almost as dangerous as fire. If you cannot swim, keep away from bridges and steep banks where you might fall in. When you are in a boat, sit quietly and don't take the chance of upsetting everybody on board.

4. *Accidents from Wires.* Never touch wires hanging from poles or trees. There may be an electric current passing through them which would give you a fatal shock.

Modern Health Crusaders.—Richard the Lion Heart, about whom you read in Chapter XI, and the other brave soldiers who went out long ago to try to free the Holy City of Jerusalem from the Turks, were called **Crusaders**. So we give the name "Crusaders" to any group of people who band themselves together to fight against some evil thing. A crusade for health and against disease is one of the things in which we all ought to be concerned. So a short time ago an organization of children was formed called "The Modern Health Crusaders," and it is said that a hundred thousand children are now enrolled. Each child who wants

Statements of Chores

FIRST WEEK

1. I washed my hands before each meal to-day.
2. I drank a glass of water before each meal and before going to bed to-day.
3. I brushed my teeth in the morning and in the evening to-day.
4. I took ten or more slow deep breaths of fresh air to-day.
5. I played outdoors or with windows open more than thirty minutes to-day.
6. I was in bed ten hours or more last night and kept my window open.
7. I tried to-day to sit up and stand up straight, to eat slowly, and to attend to toilet and EACH need of my body at its regular time.
8. I took a full bath on each day of the week that is checked (x).

Total number of chores done each day

SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.
X	X	X	X	X	X	+
X		X	X	X	X	
+	+	X	+	+	X	X
+	+	+	+	+	+	+
+		+	+	+		X
+	+		X	X	X	X
X	+	+	+	+	+	+
	X			X		+
7	6	6	7	8	6	7

Sylvia Ladd did Health Chores as indicated by the above
Name of Child

x marks, making a total of 47.....Chores in the first week.
Number

Sylvia Ladd
Signature of Child

J. F. Ladd
Signature of Parent

22 Grand St
Address

Fig. 82.—A daily chart of Health Chores for Health Crusaders.

to join is given a card like Fig. 82. Every day at bed-time his father or mother checks off each of the eight chores (given on the left of the card) that the child has done that day. At the bottom for each day is given the total number of chores done for that day. To be a Modern Health Crusader, a child must do at least forty of the chores a week.¹

I hope every child who has read this book will be at heart a Health Crusader. It does not matter, perhaps, whether you belong to the organization or not. It does matter, however, that you should want to be strong and well and fit for your country's service, and that you should want to help every one else to be strong and well for the same purpose. That is what being a Modern Health Crusader really means.

QUESTIONS FOR DISCUSSION AND REVIEW

1. Who was John Paul Jones? Tell the story of his dream.
2. What kind of people are needed to serve our country? What sort of things can you do to keep yourself fit for your country's services?
3. Alfred could not throw either very straight or very hard, when he was little. He practiced every day and at last he could throw a baseball farther and straighter than any other boy in school. What had been happening in his body while he was practicing?
4. Why is a girl who plays outdoors and sleeps with her bedroom window open more likely to be useful to her country than one who has lived most of the time in overheated rooms?

¹ For further information about Modern Health Crusaders write to the National Association for the Study and Prevention of Tuberculosis, 105 East 22d Street, New York City.

5. What are the six rules given in the text for guarding against germ diseases?

6. What is the wrong thing to do when a cinder gets in your eye? What are some of the good things to do?

7. Explain why it is that a cut or a scratch should be washed clean and covered with gauze. What kinds of wounds should always be dressed by a doctor?

8. What is the proper thing to do if your nose is frostbitten?

9. Eleanor played too near the stove and her dress caught fire. She screamed and started to run downstairs. Luckily her brother heard her and quickly threw her down on the floor and wrapped her in a rug. Why was what she did dangerous, and what he did wise?

10. George had a habit of crossing the street in the city between the cross streets, running and dodging between the automobiles. When he was told it was dangerous, he said he had never been run over yet. Was that a good argument? If not, why not?

11. What is a Modern Health Crusader? What does the word *crusader* mean?

12. What are the health chores that a Health Crusader has to do? How many of them did you do yesterday?

CHAPTER XX

PHYSICAL EXERCISES AND HOW THEY HELP YOU TO BE STRONG AND WELL

BY WALTER CAMP

Health in War and Peace.—You have all heard of the splendid work done by American men and women in the great World War, and you are all interested in knowing how to make yourselves able to do work just as great when you grow up, although we hope it will not be on account of another war. Every man who went into the army and navy, every woman who did continuous and effective Red Cross or other war work, had to be physically strong and well. In other words, in order to be useful, one must be in good physical condition; and I am going to show you how you can secure this for yourselves.

Some Rules for Health.—Boys and girls should remember that although their parents take care of them, those parents cannot possibly look after them all the time and see that no harm befalls them. If they do something that Nature does not approve of, they themselves will have to pay the price. No one can bear pain for them, no matter how sympathetic he may be. For this reason, there are many things that children should learn early. Here are a few of the most important of them:

If you get wet, don't sit down in your wet clothes, but keep moving until you have a chance to change them.

When you are heated, don't sit down in a draft or cool off suddenly, but put on a coat or wrap.

Get nine or ten hours of sleep in a room with the windows open, or else on a sleeping porch.

Keep clean and always wash your hands before eating.

Don't drink water from old wells or other places that may be polluted.

Brush your teeth at least twice a day.

Don't eat candy between meals. A reasonable amount of candy will not hurt anyone unless it takes the place of more wholesome food.

Don't hurry through your meals.

Don't wear tight clothes, such as tight shoes, tight collars, or tight gloves.

Don't read in a bad light. Rest the eyes every now and then by looking up from the book.

Don't lose your temper. Getting angry injures the health.

Don't eat when you are tired out, and don't eat when you are cross or angry. You ought not to be either cross or angry; but if you are, take time to cool off before you eat.

These are all just common-sense things which your parents or teachers tell you daily. But you are, after all, the ones who must pay attention to them, for you are the ones who will suffer if you do not.

In addition to all this, play your games. The boy

or girl who stands on one side and does not play is not only losing pleasure but is likely to lose health as well.

Set-up Exercises.—Finally, there are a few exercises or games that will help every boy to become stronger and better at his games and his work. They will also help every girl to become graceful as well as healthy. They are the same exercises in a modified form that the boys who went into the army or navy took every day.

These games we call “set-up” exercises. They are exercises to make the body grow properly, to make you stand properly, to enable you to have good lungs and a good heart, and to have, as you grow up, a better chance for that health and enjoyment which is the best part of life. I have taken the form of “set-up” that was used very largely in naval stations and aviation fields, and have adapted the exercises so that you, too, can get the benefits of them and know that you are helping your country by giving it a chance to have stronger boys and girls. With the descriptions below, and with the help of teachers or parents or big brothers, any child can easily learn to do these exercises.

WINDING UP THE CLOCK

The first of the exercises we will call “Winding Up the Clock,” because, if you do it properly, you will make circles with your hands, while your shoulders feel as though they were turning, and your shoulder blades feel as if they were almost meeting at the back.

Always stand squarely on the feet with heels separated about 5 inches, and feet pointing nearly straight

forward, arms hanging easily at the sides, chest slightly raised, and head up.

FIRST EXERCISE. Raise arms sideways to horizontal position. Turn the palms upward and force the arms back as far as possible. While in this position, count *slowly* from one to four, and at each count describe a complete circle about 12 inches in diameter, the arms remaining stiff and pivoting from the shoulders. Then reverse the direction of the circles, and do another four. See Fig. I.



Fig. I.

PLAYING THE BIRD

The second of these exercises we will call "Playing the Bird," for the motions, as you will easily see, are like those of a gull's wings, the arms and hands being lifted up to an angle of about 45 degrees and then lowered until they are horizontal. At the same time you go up on your toes and breathe in, filling the lungs as the arms go up, and letting the breath come out again as arms and feet go down.

SECOND EXERCISE. Raise arms sideways to horizontal. While taking a deep breath, raise the arms to an angle of 45 degrees, and also raise the heels until you are resting on the balls of the feet. Then, while you slowly let out the breath, come back to the original

position, feet flat on the floor, arms horizontal. Be careful not to raise the arms more than 45 degrees, or return them to below horizontal. Do this four times. See Fig. II.

UNDER THE LOW BRIDGE

The third exercise we will call "Under the Low Bridge." When you follow the directions, you will



Fig. II.



Fig. III.

find that you are stooping down with your fingers pressed against the back of your head, but that you are looking up as if you wanted to make sure that you would go safely under the bridge.

THIRD EXERCISE. Raise arms, as before, to horizontal. Place hands behind the neck, index fingers touching, elbows forced back. While in this position, bend the body slowly forward from the waist as far as possible. Keep the head up as you go down, so that

the eyes are still looking forward or toward the leader, if you are doing the exercise with a group of other children. Return to upright position, and bend backward just a little. Do not make these movements jerky and do not hurry through them. Repeat the whole movement, bending forward, then straightening up, then bending backward four times. See Fig. III.

DRINKING THE AIR

We will call the fourth exercise "Drinking the Air," for that is what it really is. By following the directions, you curl your fists up under your armpits, at the same time drawing in the breath and letting the head and shoulders go back until you are looking up straight in the air. Then, as you put the arms forward and commence to bend down, you breathe out, letting the air go slowly out of your lungs while the hands and arms go back past the body and up as high over your back as possible.

FOURTH EXERCISE. (A) Raise arms, as before, to horizontal. Move the right foot sideways 12 inches from the left. Slowly bend the fists and lower arms downward from the elbows. Then curl the fists upward into the armpits, bending the head backward meanwhile until you look upward at the ceiling. Take a deep breath as you bend the head back. Let the air begin to come out slowly, as you return to the original position, head erect, fists still in the armpits. See Fig. IV A.

(B) Then without resting, still letting the breath

come out, extend the arms straight forward from the shoulders, palms down. Let the arms begin to fall and the body to bend forward from the waist, head up, eyes to the front, until the body has bent as far as possible, and the arms have passed the sides and been forced back and up as far as they will go. Another



Fig. IV A.



Fig. IV B.

deep breath should be taken slowly as you curl your arms again, and exhaled as they come down once more.

Do the whole exercise (A and B) four times. See Fig. IV B.

SWIMMING THE CRAWL

The fifth exercise we will call "Swimming the Crawl," that is, swimming the crawl stroke, for, as one arm and hand go up in the air, the other arm and hand slide down the side of the body.

FIFTH EXERCISE. Raise arms sideways to horizontal. Turn the left palm upward; then raise the left arm and lower the right, until the right is down close to the side,

and the left is straight up overhead. Slowly bend the body sideways to the right from the waist, the right arm slipping down the right leg to or below the knee, and the left arm bending in half a circle downward over the head, until the fingers touch the right ear. Return to original position, with arms horizontal, and go down the other way, the left arm slipping along the left leg, the right arm bending downward in half a circle over the left ear. Do this four times. See Fig. V.



Fig. V.

PLAYING THE FROG

The sixth exercise is called "Playing the Frog." Here, extending the arms sideways straight out from the shoulders, keeping the back straight and standing on the toes, you go down, gathering the legs under you just as the frog does when he is preparing to leap. You should be careful to keep on the toes and to keep the body well balanced.

SIXTH EXERCISE. Move the right foot sideways until the heels are about 12 inches apart. Raise arms to horizontal. Rise on the ball of the foot. Bend the knees and, with the weight on the toes, lower the body almost to the heels, keeping the trunk as nearly erect as possible. Return to original position, knees straight, and let the heels go down to the floor. Do this four times. See Fig. VI.

SWAYING IN THE GALE

We will call the seventh exercise "Swaying in the Gale," for when your arms are extended straight up against the ears, and your hands are clasped, the body is like the mast of a ship. You sway your body around in a circle, as the mast of a ship sways in a gale.

SEVENTH EXERCISE. Raise arms to horizontal. Stretch the arms straight above the head, interlock the fingers, arms touching ears. Then, the arms being still straight up, describe a complete circle about 24 inches in diameter with the interlocked hands, the body bending only at the waist. Do this three times.

Then repeat the movement three times, in the opposite direction.

Go through the entire movement slowly and steadily, bending the body chiefly from the hips. See Fig. VII.



Fig. VI.



Fig. VII.

SOWING THE WHEAT

The eighth exercise we will call "Sowing the Wheat." Keeping the arms extended and turning at the hips, you first place one hand on the ground, bending the knee on the side towards which you go down, and keeping the other knee straight. Then, having touched the ground with one hand, you swing up and, turning the body, place the other hand on the ground in the same way, bending the other knee.

EIGHTH EXERCISE (A). Move the right foot until the heels are about 12 inches apart. Raise arms to horizontal and turn the body to the left from the hips, the arms remaining horizontal until the face is to the left, the right arm pointing straight forward, and the left arm straight backward. See Fig. VIII A.



Fig. VIII A.

(B) While in this position, bend the body from the waist, so that the right arm goes down until the right fingers touch the floor midway between the feet, and the left arm goes up. The right knee must be slightly bent to accomplish this. See Fig. VIII B. Return to the original position, body erect, arms horizontal.

Reverse the movement, turning the body to the *right* this time until the left hand points straight forward. Then bend downward until the fingers of the left hand touch the floor. Return to the original position.



Fig. VIII B.

After you have mastered the exercise, you can go through it (A and B) in one continuous motion.

Repeat the whole exercise (A and B), first to the right, then to the left, four times.

LEARNING TO FLY

The ninth exercise is called "Learning to Fly." In this exercise you lift the arms straight up over the head, taking in a good breath at the same time. Then you begin to lean forward at the waist, letting the arms come down past the hips. At the same time you let out the breath from the lungs and carry the arms back above the shoulders as you did in the exercise of "Drinking the Air." By this time, the breath is out of the lungs, and as you bring the hands down past the hips and out in front of you, you begin to inhale. Then you spread the hands and arms apart, out to the horizontal, taking in a little more breath. By the time you finally lift the hands directly above the head, as in the first motion, you have a full breath of air in the lungs.

NINTH EXERCISE. Raise arms to horizontal, taking in a slow breath; then upward until they are straight overhead. Let them fall forward and downward, while the body bends forward from the waist, until the arms have passed the sides, and been forced upward and backward as far as possible, just as in Exercise 5, Fig. V. Remember, as you bend forward, to keep the head

up, and the eyes to the front and let the breath come out.

Straighten the body upright again with the arms overhead, drawing in the breath. Lower the arms to the horizontal position, with the palms turned downward, and the arms and shoulders forced hard back. Then bring the arms out to horizontal, and begin the movement again by raising them as before.

Repeat this entire movement slowly four times, forcing the air out of the lungs as the body bends forward, and filling the lungs again as the body straightens. See Fig. IX.



Fig. IX.

MEASURING YOUR WEIGHT

The Child Health Organization of America is trying to help the children of this country to grow strong and well by keeping watch of their weight and comparing it all the time with the growth that the really healthy child should make. The two tables (pp. 241, 242)¹ show just what the weight should be for a boy or girl of a particular height. Get your mother or your teacher to help you measure your height and weight. Then find your height in the left-hand column of the table and read across the table to the column with your age at the head of it. The figure you find there is the number of pounds you ought to weigh.

The United States Bureau of Education in Washington is very much interested in this campaign for the regular weighing of the children. It is trying to get "a scale in every school" and to have each child weighed once a month. A record should be kept in the classroom (on forms which can be obtained from the Department of Documents, Washington, D. C.) of the weight of each child for each month; and monthly report cards should be sent home for the parents to keep. In this way, growth is made a sort of friendly competition in which all the children of America can take part. "The children play the game; the teachers umpire; the parents keep score."

¹ Prepared by Dr. Thomas D. Wood, and copyright, 1918, by Child Health Organization.

HEIGHT AND WEIGHT TABLE FOR GIRLS

Height Inches	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.
39		34	35	36										
40		36	37	38										
41		38	39	40										
42		40	41	42	43									
43		42	42	43	44									
44		44	45	45	46									
45		46	47	47	48	49								
46		48	48	49	50	51								
47			49	50	51	52	53							
48			51	52	53	54	55	56						
49			53	54	55	56	57	58						
50				56	57	58	59	60	61					
51				59	60	61	62	63	64					
52				62	63	64	65	66	67					
53					66	67	68	68	69	70				
54					68	69	70	71	72	73				
55						72	73	74	75	76	77			
56						76	77	78	79	80	81			
57							81	82	83	84	85	86		
58							85	86	87	88	89	90	91	
59						89	90	91	93	94	95	96	98	
60							94	95	97	99	100	102	104	106
61							99	101	102	104	106	108	109	111
62							104	106	107	109	111	113	114	115
63							109	111	112	113	115	117	118	119
64								115	117	118	119	120	121	122
65								117	119	120	122	123	124	125
66								119	121	122	124	126	127	128
67									124	126	127	128	129	130
68									126	128	130	132	133	134
69									129	131	133	135	136	137
70										134	136	138	139	140
71										138	140	142	143	140
72											145	147	148	149

About What a GIRL Should Gain Each Month

Age: 5 to 8.....	6 oz.	14 to 16.....	8 oz.
8 to 11.....	8 oz.	16 to 18.....	4 oz.
11 to 14.....	12 oz.		

HEIGHT AND WEIGHT TABLE FOR BOYS

Height Inches	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.	Yr.
39	35	36	37											
40	37	38	39											
41	39	40	41											
42	41	42	43	44										
43	43	44	45	46										
44	45	46	46	47										
45	47	47	48	48	49									
46	48	49	50	50	51									
47	51	52	52	53	54									
48	53	54	55	55	56	57								
49	55	56	57	58	58	59								
50		58	59	60	60	61	62							
51		60	61	62	63	64	65							
52		62	63	64	65	67	68							
53			66	67	68	69	70	71						
54			69	70	71	72	73	74						
55				77	74	75	76	77	78					
56				77	78	79	80	81	82					
57					81	82	83	84	85	86				
58					84	85	85	87	88	90	91			
59					87	88	89	90	92	94	96	97		
60					91	92	93	94	97	99	101	102		
61						95	97	99	102	104	106	108	110	
62						100	102	104	106	109	111	113	116	
63						105	107	109	111	114	115	117	119	
64							113	115	117	118	119	120	122	
65								120	122	123	124	125	126	
66								125	126	127	128	129	130	
67								130	130	132	133	134	135	
68								134	135	136	137	138	139	
69								138	139	140	141	142	143	
70									142	144	145	146	147	
71									147	149	150	151	152	
72									152	154	155	156	157	

About What a BOY Should Gain Each Month

Age: 5 to 8.....	6 oz.	12 to 16.....	16 oz.
8 to 12.....	8 oz.	16 to 18.....	8 oz.

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